31.

A McGRAW-HILL PUBLICATION • PRICE 50 CENTS, or 3S., PER COPY

ENGINEERING AND MINING JOURNAL

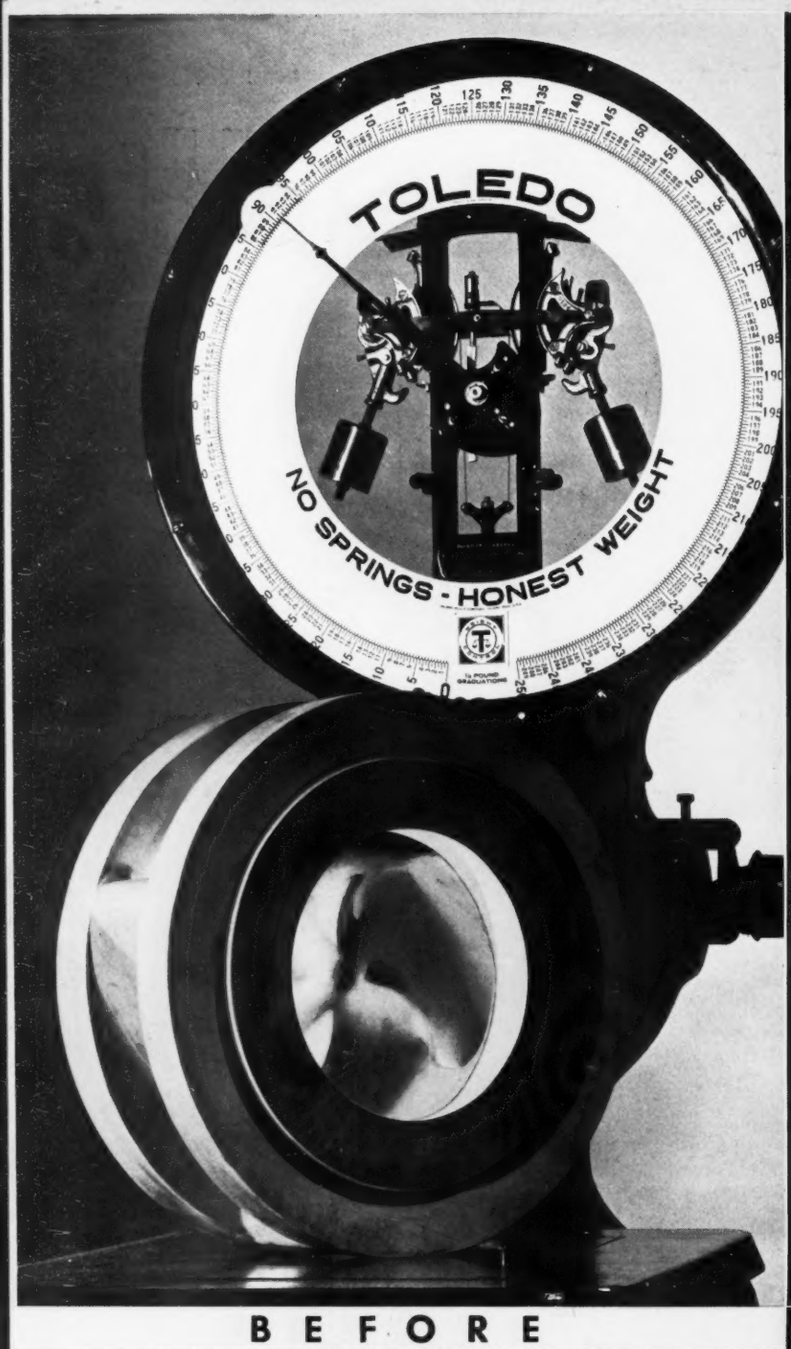
NEW YORK • SAN FRANCISCO • LONDON

MAY, 1940

In the Hull-Rust pit on the Mesabi range, iron ore operators of the Lake Superior region are looking forward to a season of heavy shipments

In this issue

Shaft Sinking in Quicksand
Laboratory's Part in Strategic Mineral Projects
Survey of Wire Rope Practice • Flotation of Mercury Ores
Split-Ring Connectors at Broken Hill
Complete Contents on page 27



BEFORE

AFTER

1,168,331 TONS PUMPED

Wear Only 1¼ lbs.—Impeller Still Good

At first glance these unretouched photographs look alike, even though one of these Maximix Rubber Impellers is new and the other one pumped 1,168,331 tons of minus 20 mesh silica rock before it was removed from the Hydroseal Pump for inspection. There was no appreciable loss in pumping efficiency, capacity, or head during the 2½ years that this impeller was in continuous service; therefore, a comparison of weight, "before"—91 lbs. and "after"—89¾ lbs., is used to measure the wear. Examination showed that this impeller is still good; therefore, it was sent to the storeroom for later installation in the pump. . . . The Hydroseal Pump in this plant delivers approximately 325 tons of sand per hour in a 1650 G.P.M. solution through an 8" line against a static head of 14 feet. . . . Address the nearest office listed below for a copy of our Catalog No. 140, which completely describes Hydroseal Slurry, Sand, and Dredge Pumps.

HYDROSEAL PUMPS

HYDROSEAL AND MAXIMIX DESIGNS ARE COVERED BY PATENTS AND APPLICATIONS IN THE MAJOR MINING CENTERS OF THE WORLD AND CAN BE PURCHASED ONLY THROUGH THESE COMPANIES

U. S. A.: THE ALLEN-SHERMAN-HOFF CO., 229 S. 15th St., Philadelphia, Pa., Offices or Representatives in most Principal Cities **CANADA: CANADA PUMPS LIMITED,** Kitchener, Ontario

AUSTRALIA: CROSSLE & DUFF PTY., LTD., 360 Collins Street, Melbourne **PHILIPPINE ISLANDS: ATKINS, KROLL & CO., INC.,** Insular Life Bldg., Manila

SOUTH AFRICA: THE DENVER MACHINERY CO., LTD., 206 Commissioner St., Johannesburg

Mining in the Philippines has furnished the topic for many a contributor to *E. & M. J.* in recent years. Of outstanding interest was the special issue of August, 1937, devoted almost entirely to the Islands. From time to time since then new developments and trends in the industry of the Commonwealth have been dealt with in various articles, as in last month's number, when Ralph Keeler, the *Journal's* correspondent in Manila, discussed the base-metal situation. In the June issue, R. D. Gilbert, superintendent for Gumaos Goldfields, Inc., will give his ideas on the geology of the ore deposits of the now important Paracale - Mambulao district in Luzon, taking issue decidedly with those who hold that the productive veins are likely to pinch out at depth.

▼

The Malay Peninsula being just across the South China Sea from Manila, one would expect engineers from the Philippines to find their way at least occasionally into the mining districts of that interesting country. E. C. Bitzer, formerly with the Benguet Consolidated and one of the contributors to the aforesaid Philippine number of August, 1937, did that very thing, going to the Raub gold area, in Pahang, one of the Federated States, where he took charge of the metallurgical work. Difficult problems offered by the Raub ore and tailings have been solved and a new tailings plant has been put in operation. Mr. Bitzer will begin his story of this work next month and follow it up at intervals thereafter with further details.

▼

A Bison, suggestive as it is of bull-headedness, with the setting sun behind him, composes the design of the Interior Department's seal which now graces all information bulletins issued for the Bureau of Mines and the Geological Survey under Secretary Ickes' regime. How appropriate!

H. C. PARMELEE
Editorial Director

ENGINEERING AND MINING JOURNAL

H. W. CLARKE
Vice-President

Published by McGraw-Hill Publishing Co., Inc.

NEW YORK • SAN FRANCISCO • LONDON

Contents for May 1940

Vol. 141, No. 5

Copyright 1940 McGraw-Hill Publishing Co., Inc.

Editorials 31

The Laboratory's Part in Strategic Mineral Projects 33
Edmund S. Leaver

Geophysical Work at Steep Rock Lake 36

Shaft Sinking in Quicksand 37
E. S. Tillinghast

Flotation of Mercury Ores 40
Lyman H. Schaffer, Joseph Newton, and A. W. Fahrenwald

A Survey of Wire-Rope Practice Yields Interesting Facts 44
F. S. McNicholas

Development of Morenci Pit Proceeds on Schedule 46
John B. Huttl

Recovery of Lode Gold in Jigs—II 48
John M. Hague

Chromate Salts From Domestic Ores 50

Re-treating Complex Tailings at Ophir, Utah 52
John B. Huttl

Split-Ring Connectors at Broken Hill 53
G. R. Fisher

Reconnaissance and Mapping Speeded by Tables 55
W. B. Phillips

Prizes for Manganese Research 57

Useful Operating Ideas 58

Summary of the Markets 60

Personal Items, Obituaries, Letters 63

News of the Industry 65

Book Reviews, Publications Received 89

Equipment News 91

COVER ILLUSTRATION: In the Hull-Rust pit on the Mesabi range. Iron ore operators of the Lake Superior region are looking forward to a season of heavy shipments. Photo by courtesy of U. S. Steel

A McGRAW-HILL PUBLICATION

McGRAW-HILL PUBLISHING COMPANY, INC.
JAMES H. McGRAW, Founder and Honorary Chairman

James H. McGraw, Jr., President
Howard Ehrlich, Executive Vice-President
Mason Britton, Vice-Chairman
B. R. Putnam, Treasurer
D. C. McGraw, Secretary
J. E. Blackburn, Jr., Director of Circulation

Editorial and Business Offices: 330 W. 42d Street, New York, N. Y. Cable Address: McGraw-Hill, New York
Branch Offices: San Francisco, 68 Post St.; Chicago, 520 N. Michigan Ave.; Washington, D. C., National Press Building.

McGRAW-HILL PUBLISHING COMPANY, LTD.
Aldwych House, Aldwych, London, W. C. 2, England Cable Address: Backlash, Estrand, London

Y. C. G. F. No. 20 (Yuba No. 135) has 18 cu. ft. buckets capable of digging 124 ft. below water against a bank 50 ft. high. Designed and built for use at Hammonton, California, 1939.

Dredges Designed and Built by Yuba

ARE BACKED BY OVER 30 YEARS CONTINUOUS FIELD EXPERIENCE

Ever since Yuba's predecessors—Yuba Construction Co., Western Engineering & Construction Co. and Boston Machine Shop—led in developing the "California" type dredge; with spuds, single lift bucket line, and conveyor belt stacker; Yuba engineering has been based on operating experience.

From those early days in Yuba's history, association and cooperation with operators in developing their ideas have guided Yuba design—have earned for Yuba dredges worldwide approval from experienced dredge men.

Continuously, for more than 30 years, Yuba has specialized in placer dredge design, manufacture and construction. The following dredges, designed and built ***to specifications by Yuba*** or its predecessors, prove that today Yuba has unequalled experience from which to design and build a modern placer dredge for your property.

Contract Date		For	Location	Bucket Size "cu.ft."
1905	Yuba Cons. Gold Fields, No. 3	Gold	California	7½
1905	Yuba Cons. Gold Fields, No. 4	Gold	California	7½
1905	Yuba Cons. Gold Fields, No. 5	Gold	California	7½
1905	Yuba Cons. Gold Fields, No. 6	Gold	California	7½
1906	Yuba Cons. Gold Fields, No. 7	Gold	California	7½
1906	Yuba Cons. Gold Fields, No. 8	Gold	California	7½
1906	Boston & Oroville Mining Co., No. 4	Gold	California	7½
1906	Feather River Dev. Co. (Natomas No. 1)	Gold	California	7½
1906	Marysville Gold Dredging Co., No. 1	Gold	California	7½
1906	Marysville Gold Dredging Co., No. 2	Gold	California	7½
1906	Oroville Dredging Ltd., Exploration No. 3	Gold	California	7½
1907	Yuba Cons. Gold Fields, No. 9	Gold	California	7½
1907	Yuba Cons. Gold Fields, No. 10	Gold	California	7½
1908	Feather River Dev. Co. (Natomas No. 2)	Gold	California	8
1908	Natomas Development Co., No. 1	Gold	California	13½
1908	Natomas Development Co., No. 2	Gold	California	8½
1908	Natomas Development Co., No. 3	Gold	California	8½
1908	Yuba Cons. Gold Fields, No. 11	Gold	California	7½
1908	Yuba Cons. Gold Fields, No. 12	Gold	California	7½
*1909	Shasta Dredging Co.	Gold	California	5
*1909	Viloro Syndicate	Gold	California	5
*1910	Siskiyou Dredging Co.	Gold	California	5
1910	Pato Mines (Colombia) Ltd.	Gold	Colombia	8½
1910	Wild Goose Mining & Trading Co.	Gold	Alaska	3½
1910	Boston & Idaho Gold Dredging Co.	Gold	Idaho	15
1911	Natomas Cons. of Calif. (F. R. No. 3)	Gold	California	15
1911	Yuba Cons. Gold Fields, No. 13	Gold	California	15
1911	Natomas Cons. of Calif., No. 8	Gold	California	13½
1911	Natomas Cons. of Calif., No. 9	Gold	California	15
1911	Natomas Cons. of Calif., No. 10	Gold	California	15
1911	Kirtley Creek Dredging Co.	Gold	Idaho	9
*1912	Natomas Cons. of Calif., No. 7	Gold	California	9
*1912	Natomas Cons. of Calif., No. 8	Gold	California	15
*1912	Orsk Gold Fields	Gold	Siberia	3½
1912	Powder River Gold Dredging Co., No. 1	Gold	Oregon	9
1912	Shovel Creek Gold Dredging Co.	Gold	Alaska	2½
1913	Malaguit Dredging Co.	Gold	P. I.	5
*1913	Bohannan Creek Dredging Co.	Gold	Idaho	6
*1914	Yuba Cons. Gold Fields, No. 3	Gold	California	7½
*1914	Yuba Cons. Gold Fields, No. 4	Gold	California	7½
1914	Yuba Cons. Gold Fields, No. 14	Gold	California	15
*1914	Yosemite Dredging Co.	Gold	California	3¾
1915	Powder River Gold Dredging Co., No. 2	Gold	Oregon	7½
1915	Yuba Cons. Gold Fields, No. 15	Gold	California	18

ENGINEERING AND MINING JOURNAL

H. C. PARMELEE, Editorial Director
New York: A. H. HUBBELL, Associate Editor
H. C. CHELLSON, W. N. P. REED, Assistant Editors
H. H. WANDERS, Market Editor
San Francisco: J. B. HUTTL, Assistant Editor; G. J. YOUNG, Consultant
Washington, D. C.: PAUL WOOTON

NEW YORK • SAN FRANCISCO • LONDON

Volume 141 MAY 1940 Number 5

Strange Metal Markets

AFTER EIGHT MONTHS of war in Europe, the outlook for non-ferrous metals still remains uncertain. The heavy buying that occurred last fall and the extra demand on the industry for larger supplies stimulated production; but fortunately plant and equipment were in excellent condition, and production and consumption soon were brought in balance. In fact, since the first of this year stocks of copper, lead, and zinc held by producers in this country have increased moderately.

Much of the nervousness over the price situation, so evident in the first month of the war, has disappeared. No doubt many producers have been disappointed over the price record of the past eight months, because the war has not greatly forced prices upward except in a few instances. The following figures tell the story:

	Aug. 31, 1939	April 30, 1940
Copper, delivered, ¢ per lb.....	10.500	11.250
Lead, New York, ¢ per lb.....	5.050	5.100
Zinc, St. Louis, ¢ per lb.....	4.750	5.750
Tin, New York, ¢ per lb.....	49.250	47.125
Aluminum, delivered, ¢ per lb....	20.000	19.000
Antimony, New York, ¢ per lb...	12.000	14.000
Nickel, New York, ¢ per lb.....	35.000	35.000
Manganese ore, ¢ per unit.....	28.000	49.000
Tungsten ore, $ per unit.....	16.000	22.000
Platinum, New York, $ per oz....	38.000	38.000
Quicksilver, New York, $ per flask	88.000	171.000

That metals like copper, lead, and zinc have not done better pricewise under war conditions may be attributed chiefly to the fact that actual combat so far has not taken large tonnages much beyond the fabricating stage. The boom in copper in the last quarter of 1939 was helped along in no small measure by the heavy demand for the metal from Russia. Since then domestic copper has suffered because of a steadily shrinking foreign market. Now the unfavorable turn of events in Scandinavia still further narrows the foreign market for various metals.

Straits tin has declined in price in the eight-month period to the extent of 2⅛¢ a pound, under ample supply. Since the outbreak of hostilities the rate of tin production has actually been reduced by the Tin Committee. Quicksilver has been in a class by itself. War demands have been large, but the advance in price initiated by the European Cartel seems to have anticipated gains in consumption that may yet grow out of the war. Both chrome and manganese ores have advanced in price largely because of the sharp upturn in ocean freight rates.

The end of April finds the world so situated that no real shortage exists in any of the essential non-ferrous metals. Yet the future is unpredictable, and the best opinion in market circles is subject to change without notice.

Careers in the Bureau of Mines

FOLLOWING the last upheaval of personnel in the Bureau of Mines, the sentiment was freely expressed by several organizations of mining men that a mining engineer should again be appointed to the directorship. This was a logical expression of professional pride in a technological bureau in which, it was felt, a trained engineer should find a satisfactory career.

This policy prevails in other similar bureaus. Barring political domination and meddling, such as has plagued the Bureau of Mines in the last seven years, the system works well. The individual finds satisfaction in his work and the Government surrounds itself with groups of experts in which the related industries have confidence.

When it was announced that Dr. R. R. Sayers would be Acting Director of the Bureau of Mines, reaction was diverse. Those who know him approved the appointment. They recalled that for fifteen years he had served as Chief of the Health and Safety Branch of the Bureau, and that he was familiar with many aspects of the mining industry. They thought he would make a good administrator. But admitting these things, and with no prejudice against Dr. Sayers, others felt that a mining engineer of recognized ability should head the Bureau and enjoy a career free from political interference.

Appointment of Dr. Sayers as "Acting Director" may have some significance. It may have been made to quiet the resentment of the mining industry over the high-handed tactics of Mr. Ickes. Certainly the wording of the official announcement was unusual. (The italics are ours.) "President Roosevelt has *detailed* Dr. R. R. Sayers as Acting Director of the Bureau of Mines. . . . Dr. Sayers *is* senior surgeon of the United States Public Health Service. . . . Dr. Sayers will take over his new position *on detail* immediately." One might be justified in assuming, from this precise use of the words italicized, that the appointment is temporary, and that later a "career" appointment will be made. Whether this interpretation proves to be right or wrong, we offer it, and all these comments, with best wishes to Dr. Sayers for a successful administration in which he will also find personal satisfaction.

A Career Man Retires

SPEAKING OF CAREERS in the government service, we note with regret the voluntary retirement of J. W. Furness, Chief of the Economics and Statistics Branch of the Bureau of Mines. Under his direction the economic and statistical service of the Bureau steadily expanded in timely importance and efficiency, and the various divisions of his branch became the source of invaluable world-wide information on the mineral industries. He leaves a fine heritage to the Bureau. Not only was his professional work of a high order, but he brought to it personal qualities of loyalty and integrity that are sometimes lacking in public servants. He resisted political pressure to the utmost, and stood his ground against popular clamor. As an adviser to the Army and Navy Munitions Board he helped to draw specifications for strategic minerals, and followed scrupulously the intent of the law. Mr. Furness will be missed in the ranks of the Bureau. Although retired, we surmise that his talent for mineral economics will still be sought and turned to good account.

Prospectuses Then and Now

RECALLING the carefree manner and unrestrained enthusiasm with which the gay promoter used to float mining stock, we were forcibly impressed recently with the sober and cautious wording of the prospectus of a new mining corporation. In large type and red ink at the top of the first page we read: *"This offering is a speculation and should be accepted by venture capital only."* A little farther down we note that, although the securities have been filed with the Securities and Exchange Commission, they have not been approved by that body; also that it is a criminal offense so to represent. Plainly tabulated are the price of the shares to the public, the underwriter's commission, other estimated expenses, and net proceeds to the corporation.

With this information clearly stated, the prospectus continues with an outline of the industry in which the corporation intends to engage. Various authorities are quoted, one of whom is identified as the prospective general manager of the mine to be operated by the corporation. Statistical data are offered on the commodity to be marketed: price, production, imports, exports, and stocks. The history and present condition of the mine are reviewed, and the development program is outlined. Management and promoters are identified. In short, the buyer of stock in this speculative offering has a pretty clear picture of the enterprise and the industry, and the intended use of his money.

It excites the imagination to wonder what George Graham Rice might have done with this promotion in the good old days of irresponsibility and carlessness with the truth. Certainly he would not have labeled his offering as "a speculation," nor would he have invited "venture capital only."

Swedish Iron—War Prize

WHEN MR. HITLER DECIDED to "extend protection" to Norway, it was clear that Germany's primary interest in the whole Scandinavian peninsula was a continuing supply of iron ore from Swedish Lapland, north of the Arctic Circle. Except in Winter, when the Gulf of Bothnia is not navigable, this ore can be shipped to Germany from Swedish port of Lulea, without interference by the Allies. But from December to April the Gulf of Bothnia is frozen, and the ore moves by rail 100 miles to the ice-free port of Narvik, Norway. Shipping from that port is not so easily protected. And inasmuch as about seventy per cent of the annual tonnage of Swedish Lapland ore moves out through Narvik, that port becomes a strategic point in military operations.

How important this ore is to the German economy is found in the statistics. In 1938 Germany took 71 per cent, nearly nine million tons, of Sweden's total exports of iron ore, concentrates, and briquets. And this tonnage comprised 40 per cent of all German imports of iron ore that year—obviously a substantial item in war supplies.

Incidentally, the iron-ore deposits in the Province of Lapland, Sweden, are among the largest in the world.

The Laboratory's Part in STRATEGIC MINERAL PROJECTS

Reno Experiment Station of the United States Bureau of Mines completed 4,580 analyses and tests on samples received in fourth quarter of 1939 from the investigations under way

Edmund S. Leaver
Supervising Engineer,
Precious Metal Section,
Metallurgical Division,
U. S. Bureau of Mines, Reno, Nev.

At the sampling plant. A view of the stock of ore samples received and the open-air drying furnace

WHEN FUNDS were made available for strategic-mineral investigations by the Bureau of Mines, as authorized by Section 7 of Act Public 117, 76th Congress, no one station had adequate sampling and analytical equipment to do the preliminary testing rapidly and efficiently. The personnel at the Reno station was increased, and additional laboratory facilities were provided for this special investigation. When preliminary testing has been done the concentrated samples will be routed to the appropriate station for completion of the metallurgical work. These pages deal with the methods of handling large numbers of field samples as they are received at this station from various projects.

Relatively large samples, each made up of 1 to 15 large canvas sacks, have been received in lots ranging from several tons to 30-ton carloads. Chrome ore has been shipped from the vicinity of Casper, Wyo.; Columbus, Mont.; and John Day, Ore.; tin ore from Tinton, S. D., and Silver City, N. M.; antimony from Yellow Pine, Idaho; tungsten from Nightingale, Nev.; and nickel from Bunkerville, Nev.

Four thousand five hundred and eighty analyses and tests were completed on samples received during the quarter ended Dec. 31, 1939. The handling of so many large individual samples to obtain a truly representative pulp for each called for installation of special-size sampling equipment not found in the usual mine, smelter, or custom sampling plant.

The old Bureau building, formerly used for electrolytic manganese large-scale research work, was reconditioned and the needed machinery added.

A copy of the analytical results for each project is forwarded by air mail daily to the field engineer in charge of the respective project to aid him with the development work. Results covering all tests and analyses as completed each day are mailed to the headquarters of the Mining Division for correlation with its field data in preparing estimates of the available ore of various types and grades.

Many of the samples, particularly those of the chrome ore from Casper, Wyo., were so wet that it was necessary to dry them before attempting to crush them. For this purpose a temporary open-air drier with about 60 sq.ft. of drying surface is used. An inclosed drying furnace of the same capacity has been erected within the building.

The drying surface in this furnace is made with three steel plates (size 3 ft. 4 in. by 6 ft. by 1 in.), formerly used for floor plates. They will not warp or buckle under the drying heat used. A two-door wood-burning fire box (size 1x3x4 ft.) is provided. The bottom drying plate sits level, with one end resting on top of the brick wall, 18 in. high, that forms the exit side of the firebox. It is also supported by the back and end walls plus two brick arches in front. The second steel plate is set 18 in. above the bottom plate and projects 6 in. into the firebox; and the third steel plate is 18 in. above the middle plate and covers the top of the firebox. The front is closed by sliding steel doors. A chimney at the end controls the draft. The samples to be dried are placed in square-type rounded-corner tubs, which are placed under, between, or on top of the drying plates.

All of each dry sample is crushed to about ¼ in. in a 7x10-in. jaw crusher and caught in 1x1x1½-ft. heavy galvanized pans with handles on each end. The sample is then passed into the square hopper of a 16 in. by 6 ft. standard-type belt ore feeder, which delivers it at a controlled speed into the feed hopper of a 4x18-in. set roll spaced to crush to about 10 mesh. Parts are brushed clean after each sample.

All of each sample passes the rolls and is caught in a 2x3-ft. by 10-in. pan. It is transferred to square-type tubs and further mixed three times by pouring from tub to tub. It is then

---

Published by permission of the Acting Director of the Bureau of Mines, United States Department of the Interior.

Previous papers prepared by the Mining Division of the Bureau of Mines appearing in the *Engineering and Mining Journal* show the progress of strategic-mineral field projects.

split through a 10x18-in. Jones sampler and resplit down to about 20 lb., then crushed further by a No. 2 cone sample grinder to about 20 mesh. It is then thoroughly rolled and again split through an 8x8-in. Jones sampler to the amount used in the assay pulps. This is thoroughly dried in an electric drier and ground to pass 100 mesh by a direct-connected disk pulverizer. It is rolled again and divided into an original and a duplicate sample. The original is used for analysis and the duplicate filed for possible future reference.

All samples, as received from the field, are marked by the field engineer with a tag inside and another outside of each sack. These tags follow each sample through the course of preparation. The inside tag is included within the final pulp envelope and thus accompanies this sample to the analytical laboratory. The outside tag goes into the large canvas sack containing the remainder of the original sample to minimize the chance of any mistake in markings of each sample.

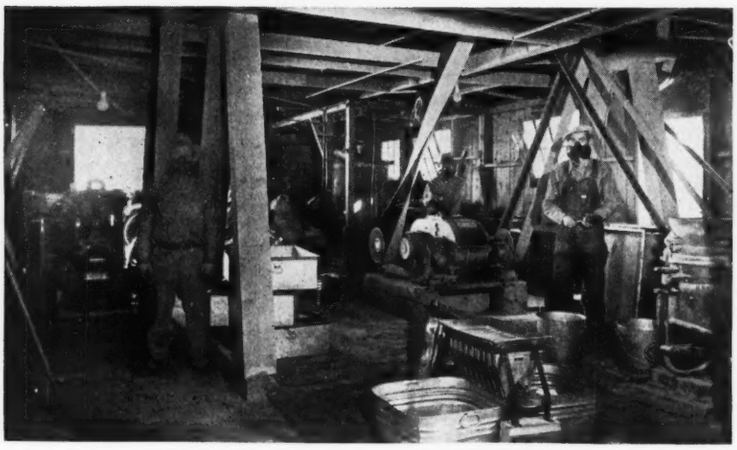
All samples from each project that contain strategic metals in amounts that even approach marginal values are reserved for metallurgical research to determine the best possible recovery method. The sample representative of ores containing each strategic mineral are to be forwarded to the particular Bureau experiment station that is in the best position to carry on the research to indicate the method for the recovery of contained metal.

A V-belt-driven chipmunk crusher is provided for crushing hand samples, and each of these crushed samples goes to the cone sample grinder and then follows through as "per-cuts" from larger samples.

Four analysts have been added to the original staff of the Reno Station. Two additional new hoods complete, including both electric and gas hot plates, have been installed. Six work benches are provided with the usual glass and sundry apparatus to meet the need of each analyst for handling rapidly the many various strategic-metal analyses.

The Mining Division of the Bureau furnishes a representative sample taken at each project from which it decides to forward a considerable number of strategic-mineral ore samples for analysis. Special study is given each of these representative samples by the Bureau's older experienced chemists to determine the best or most satisfactory methods of analysis to meet the particular conditions. The following indicates the present analytical procedure:

Tungsten — Nightingale district. Scheelite ore. Contact-metamorphic deposit. Associated minerals, chiefly garnet, epidote, quartz, and calcite, with minor amounts of pyrite, chalcopyrite, and iron and manganese oxides.



Inside the plant—the jaw crusher, rolls, cone sample grinder, and the Jones sampler. Note the respirators used by the men for protection against dust

The analytical method is based upon the procedure in Vol. I of the fourth edition of Scott's "Standard Methods of Chemical Analysis." Beginning with the procedure described on page 561, the following modifications are introduced: Five grams is ground to pass a 200-mesh screen and 200 rather than 100 ml. of concentrated HCl is employed for dissolution. The procedure is followed until line 9, page 562, is reached. At this point 5 ml. of concentrated HNO_3 is added, the cover replaced and the sample boiled until danger of spattering is over. The cover glass is removed, and the volume reduced to 15 ml.

After the concentrated solution is diluted with 200 ml. of hot water, 6 ml. of cinchonine solution is added. The mixture is brought to a boil and kept hot at least one-half hour.

The rest of the procedure is generally followed without alteration.

Some chemical laboratories in the mining industry have experienced difficulty in obtaining uniform, accurate tungsten analysis. The following points seem to need emphasis: Grind the ore to pass 200 mesh; use a large excess of concentrated HCl; and heat to 60 deg. C. for at least one hour. This appears to be necessary to dissolve the minerals of tungsten. Best results have been obtained by using cinchonine as a precipitating agent. The precision under the procedure outlined has been found to be accurate to as low as 0.05 per cent.

Chromite—The ore of the Casper, Wyo., deposit occurs as chromite in silicate gangue; pyrite is the predominant mineral. Ore from Benbow, Stillwater County, Mont., is massive chromite disseminated with magnetite.

One-half gram of sample is mixed with 5 grams of sodium peroxide in a porcelain crucible. The mixture is fused for 5 to 6 minutes in a homemade muffle. (The muffle is described later under the tin method.) After cooling, the crucible with the fused mass is placed in a 1,000-ml. beaker, covered with water, and boiled for 10 minutes to decompose peroxide. It is allowed to cool for a few minutes, and 1–1 sulphuric acid is added until the precipitate disappears plus 25 ml. in excess. If the solution is warm, the dilute sulphuric acid has to be added carefully. The crucible is next removed from the beaker and its contents are washed thoroughly with water, which is added to that in the beaker. The solution is then cooled to room temperature, and this may be hastened by placing the beaker in shallow running water. Next the solution is diluted to 700 ml. with water. Ferrous sulphate is added until the chromate color has disappeared, plus to the next 5-ml. or 10-ml. mark on the burette. Excess ferrous sulphate is determined by back titrating with potassium permanganate. Ferrous sulphate has to be checked against standard potassium permanganate daily. The chromium factor for the ferrous sulphate is obtained from the permanganate standard.

The method assures speed without sacrifice of accuracy. Important features are fusion of many samples at the same time by utilizing a cheap homemade muffle; elimination of all filtration operations; and elimination of operations for removing permanganate. The last two features are obtainable by the introduction of porcelain crucibles for fusion in place of the usual iron or nickel crucibles.

Manganese—Twenty-five hundredths of a gram of ore is digested with 10 ml. of concentrated HCl for 10 minutes, 10 ml. of 1–1 sulphuric acid is added, and the solution is evaporated to fumes. It is cooled, diluted, and transferred to a 250-ml. volumetric flask. The usual technic to insure complete transfer of solution to flask must be employed. Dilute to 250 ml., shake until homogeneous, and transfer a 25-ml. aliquot part to a 500-ml. Erlenmeyer flask; 10 ml. of sulphuric acid-phosphoric acid mixture and 10 ml.

Another view of the interior of the sampling plant. The equipment seen includes the chipmunk crusher, disk pulverizer, bucking board, and electric drying oven.

of 0.5 per cent silver nitrate solution are added. The solution is diluted to 150–175 ml. and brought to a boil, removed from hot plate and 10–15 ml. of 25 per cent solution of ammonium persulphate added. Then it is returned to the hot plate and boiled 1 minute, and the flask cooled by putting in a tray into which cold water is running. When cool, it is titrated with a standard sodium arsenite solution. When 1 ml. of sodium arsenite equals 0.0005 gram Mn, 1 ml. sodium arsenite equals 2.0 per cent manganese. The manganese is therefore reported to one decimal place only.

Utilization of the sulphuric acid-phosphoric acid mixture greatly extends the usefulness of the method detailed in the foregoing, because the limit of the amounts of manganese that are determinable is increased. The sulphuric acid-phosphoric acid mixture is made up of: Water, 900 ml.; phosphoric acid (85 per cent), 1,200 ml.; and concentrated H_2SO_4, 900 ml.

This procedure covers the range of ores from 10 to 50 per cent nicely. Outside this range the aliquot part will have to be changed to achieve the best results. If too large a quantity of manganese is present, MnO_2 will be precipitated. In this instance a smaller aliquot must be taken.

The procedure is an adaptation of the old persulphate-arsenite method employed by the steel industry. The modifications introduced into the method are based upon facts found in recent publications. For a good summary of these facts see Frank W. Scott, *Chemist-Analyst*, May, 1938.

Attention is called to the fact that in this method the second decimal place has been sacrificed to speed. However, in the region of 10 to 50 per cent, this decrease in accuracy is sufficient evaluation of prospect samples.

Antimony—The Yellow Pine, Idaho, deposit occurs in silicified granite as stibnite, associated with pyrite arsenopyrite and oxidation products of these minerals, with additional values in both gold and silver.

The analytical method used follows: References to "Technical Methods of Ore Analysis," by H. H. Low. John Wiley & Sons, Inc., New York. Seventh edition, page 27, 1914. This method utilizes hydrogen sulphide precipitation in concentrated hydrochloric acid to remove arsenic. The antimony sulphide is precipitated in more dilute hydrochloric acid. The antimony is eventually titrated with $K_2Mn_2O_8$.

Tin—Tinton, S. D., deposits occur as pegmatite containing cassiterite, columbite, tantalite, tourmaline, quartz, feldspar, and mica.

The Catron County, N. M., deposit is altered rhyolite with phenocrystalline quartz and feldspar. The mineral cassiterite usually is closely associated with hematite and magnetite.

The method of analysis employed is as follows: Measure about 8 grams of sodium peroxide into each of six No. 3 crucibles, and add 1.20 gram (double factor-weight) of ore. Mix pulp and peroxide thoroughly, and place in a hot gas muffle; heat until perfectly fluid (5 to 6 minutes), remove from muffle, cool, and place in 400-ml. beakers. Cover with cold water, and add (cautiously at first) concentrated HCl. until the precipitate is dissolved and then 50 ml. in excess. Transfer solution to 500-ml. Erlenmeyer flask and dilute to 200 ml. with water. Add 10 grams granular test lead, and boil gently on hot plate for 45 minutes after color of ferric iron disappears. Cool to about 10 deg. C., and titrate with N/10 iodine solution, using starch as indicator. One milliliter = 0.5 per cent tin.

A cheap but efficient muffle for sodium peroxide fusions can be assembled in a few minutes. Six fusions can be made simultaneously, and if one should boil over or burn through, the damage can be repaired immediately without expense or loss of time. A dozen magnesia brick (2½x4½x9 in.), two hard brick for cover having a combined width of 10 in., one Alundum extraction thimble (1¼ in. diameter), and a Fisher burner are necessary.

Arrange nine brick to form a block 7½ in. high, 13½ in. wide, and 9 in. long. Remove the top center brick and place it on edge in front of the space. This is the rest for the Fisher burner. Now place two more at the back of the pile as close as possible, edgewise and one on top of the other. The top is now 1½ in. above the "block U."

Put the cover brick on so that an open space of about ¾ in. is left at the back for a chimney. No cement is necessary or desirable. Rest the base of the burner on the table and the top just at the outside of the front brick. Lay the thimble so that it deflects the flame under the top brick.

Full blast should be used until the muffle is red hot and then cut back until only a small flame shows at the open space at the back. A good oxidizing flame at moderate pressure will fill the rear three-fourths of the muffle. If the back crucibles get most of the heat, close the air part way and bring flame forward.

Heat is deflected down toward the melt, so it is important to keep the part of the muffle containing the crucibles evenly filled with flame. In 5 to 6 minutes a clear fusion is obtained. If the temperature is too high the melt is likely to boil or the crucible to fail. A longer fusion time is unnecessary for decomposition of cassiterite or chromite and shortens the life of the crucible. A crucible ought to last four or five fusions.

Nickel—Ores from the project in Clark County, Nev., occur in a basic dike rock, probably peridotite, containing nickel sulphide closely associated with chalcopyrite and accompanied by considerable pyrite. Copper, gold, silver, and platinum-group metals occur with the nickel.

The analytical method utilized is found in "Inorganic Quanitative Analysis," by H. H. Fales, published in 1925 by the Century Company, New York. It is modified as follows: Copper is first separated by H_2S and the copper sulphide is utilized for the copper determination. The nickel is determined in the filtrate from the CuS precipitate and eventually is precipitated with dimethyl gloxine.

In considering simplified procedure for each element in a particular ore it is essential to know that certain interfering elements are absent. For instance, managanese will interfere with chromite procedure, and although its absence may be shown in the pilot representative sample, diligence is exercised to prevent even minor errors by examining products, color of solution, etc. Some methods chosen probably will be changed in certain details after further study indicates an improvement.

It is expected that this analytical work may lead to the further development of preferred methods that will be worthy of publication.

Geophysical Work at Steep Rock Lake

It has served to trace extensive occurrences of iron ore and helped to develop a method for prospecting from ice

THE GEOPHYSICAL WORK at Steep Rock Lake, in northwestern Ontario, where Steep Rock Iron Mines, Ltd., of Toronto, has been exploring an important deposit of hematite, as told on pages 46 and 47 of the April issue of *E.&M.J.*, was carried out by a University of Toronto party, consisting of Dr. Arthur A. Brant and A. R. Clark, of the physics department, and certain students who were studying in the geological and physical sciences. Dr. Brant spent the winter seasons of 1937–38 and 1939–40 as well as the summer vacations of 1938 and 1939 on the property. The objective of the work was to study the limitations of certain of the geophysical methods and to attempt to develop suitable means for prospecting from ice. It was felt that this would be extremely useful in future mining development in Canada, inasmuch as approximately 60 per cent of the northern region consists of water and muskeg. Magnetic and electric surveys were carried out in the middle and west arms of Steep Rock Lake from January to March, 1939. The basis of the survey was as follows:

By magnetic methods the contact between the magnetic pyritiferous tuff and the non-magnetic ferrodolomites could be accurately located. This contact was then explored electrically. The dense hematite being electrically resistant, and the surrounding dolomite and tuff conducting, it was possible to indicate the presence of hematite by electrical measurements. In this manner, then, a hematite body lying in the northern part of the middle arm of the lake was traced from the location indicated by the few drill holes put down during the winter of 1938 for 3,500 ft. In addition, the presence of hematite in considerable quantity was indicated at Mosher Point, about 8,000 ft. south of the first orebody. The work at Mosher Point was supplemented by other work here in 1940. The work in West Bay indicated the presence of tuff and ferruginous lime breccia. However, electrical work seemed to indicate that with the exception of about a thousand feet directly west of the narrows, the contact appeared too tight in comparison with that of the middle arm to infer the presence of ore. Central parallel line and single point electrode methods were attempted. The electrical method finally evolved was as follows:

A near current electrode and two potential electrodes were kept constant distances apart and were moved perpendicular to the strike of the formations towards a far distant electrode. The electrodes consisted of approximately 10-ft. lengths of $\frac{3}{4}$-in. iron pipe which were lowered into the water through holes bored in the ice by means of an electrician's drill.

During the winter of 1940 magnetic electrical and gravity surveys of the east arm were attempted. Again it was possible to trace the tuff lime contact magnetically and to direct the already started drilling in the northwest corner along the magnetically established contact. The lime-tuff contact to the east of East Bay was explored electrically by the method indicated. Substantiary drilling on the property has just begun. The discussion of the interpretation of these results has been omitted.

In addition, torsion-balance measurements were carried out over the north half of East Bay with the aim of establishing the presence of denser hematite ore. With the depths of water and clay above bedrock known, it is possible by the use of charts to correct the torsion-balance measurements for the underwater topographical feature. The correct results, if dealt with in the customary fashion, should indicate the presence of ore; for example, the hematite body, 500 or 600 ft. long and 150 ft. broad to a depth of 500 to 600 ft., should cause an anomoly of about 15 Eötvös units gradient. The electrical measurements were used in addition in the attempt to determine topographical features and with some success, but sharp topographical changes could not be determined with sufficient accuracy. Hence after break-up the attempt will be made more accurately to determine the thickness of clay by a sonic arrangement. It is hoped that the final gravitational results may serve to indicate the extent and breadth of the orebody already indicated by drilling in East Bay and the presence of others along the unexplored section of the contact. In addition, a Boliden gravimeter was tried out, but the seismic construction of the instrument reacted so violently to the vibrations of the ice caused by the underlying water waves that measurements with it could not be made.

Safety Code Authorized for Quarry Operations

CONCERN for the safety of workers in quarry, strip, and open-pit mining resulted in the authorization of a new safety code project at a meeting of the American Standards Association held in New York on April 18. The need for such a code has been under consideration for some months in safety and mining circles, and the action taken was influenced by the results of a canvass in which the following 23 organizations backed the proposal to develop one and expressed a desire to participate in its development:

U. S. Bureau of Mines; Ohio Ceramic Industries Association; Pickands, Mather & Company; International Association of Industrial Accident Boards and Commissions; Industrial Safety Equipment Association; Pennsylvania Department of Labor and Industry; American Association for Labor Legislation; International Association of Governmental Labor Officials; Tennessee Valley Authority; Works Progress Administration.

National Association of Mutual Casualty Companies; National Electrical Manufacturers Association; American Iron and Steel Institute; National Conservation Bureau; Mine Inspectors' Institute of America; American Institute of Electrical Engineers; American Mining Congress; American Society of Mechanical Engineers; National Lime Association; National Safety Council; U. S. Department of Labor; National Coal Association; Coal Mining Institute of America.

A committee representing these organizations and others will take charge of the technical work involved in developing standards.

Because of the accident hazard in quarry, strip, and open-pit mining, many states have instituted their own regulations for quarry operations. The National Safety Council has also studied the problem and issued a "Safe Practices Pamphlet" on the subject. A primary job of the new committee will be coordinating these many existing Federal, State, and city codes.

The work when completed will serve as a guide to safe practices for quarry and mine owners, and will also be available to insurance interests, governmental bodies, or other groups.

Water was encountered in rock at shaft where 6-ft. shoe was used to sink through about 60 ft. of quicksand. This was at the station for the level, well into the ledge

Shaft Sinking in Quicksand

The details of a safe procedure for this hazardous class of work

E. S. Tillinghast
General Superintendent
Inter-State Iron Company
Calumet, Minn.

EVERY shaft-sinking job, particularly in quicksand, offers new problems and provides unlimited opportunity for all the ingenuity and resourcefulness the engineer may possess. Sinking through quicksand is always hazardous and success is never assured until the shaft is safely tied into solid material. Even then one must be certain that no small openings exist in the portion that is in quicksand, through which that elusive material could escape and, perhaps, undo in a short time the work and expense of months of hard fighting.

Frequently what is called quicksand is an extremely fine clay, so fine as to be practically free from grit. But this fine clay is just as "quick" as the sand and the method of handling it is the same.

Going through such material by compressed air with caissons, locks, and sand hogs has become a well-developed procedure, and many important engineering undertakings, such as the construction of foundations for large buildings or bridges and tunnels driven under river beds, have been successfully completed by this method. When the project is of sufficient size to warrant the expense, it has many advantages and may well be the best one for the purpose, and in some operations it is the only feasible method. The cost may be estimated with reasonable accuracy by companies engaged in such work, and there is little doubt as to the satisfactory conclusion of the contract.

Another method, which has been employed more in Europe than in this country, is that of pre-freezing the quicksand through which a shaft is to be sunk. This is accomplished by circulating a refrigerating solution through pipes sunk around the shaft location, to a depth below the quicksand, until a frozen ring of the necessary diameter and thickness is formed, permitting excavation to proceed within it. This plan was considered for sinking a shaft to the buried meteor in Meteor Crater, Arizona, and it was used for driving two tunnels under the Scheldt River at Antwerp, Belgium.

But this method, too, is expensive and requires special experience, equipment, and facilities not possessed by the average mining company. Where a shaft is planned through quicksand ground, the problem usually resolves itself into one of devising a means of getting the shaft down, using the men, materials, and equipment available or readily obtainable. The engineer on the job is expected to get the work done without calling in high-priced, outside operators. He is there for that purpose. To meet these conditions at a property where several quicksand shafts were required over a period of years, the following method was employed:

The most important feature of the method is the "shoe" (shown in the accompanying photographs), which is forced on ahead of actual digging. The height of shoe required depends upon the thickness of quicksand expected, the depth at which it is located, and the consequent water pressure which will result. This height may vary from 2 ft. for a thin layer of sand to 6 ft. or more where 30 to 50 ft. of water-saturated quicksand lies between surface and ledge. It is better to have the shoe higher than necessary than to risk having it too low. The shoe may be constructed in any fairly well-equipped mine shop having facilities for drilling, cutting,

and welding heavy steel plates; but it must be made carefully to the dimensions called for in the specifications to avoid trouble when it is assembled in the shaft.

Shafts put down with the shoe may be hanging or drop shafts or a combination of both. Where there is a sufficient depth of firm, dry ground above the quicksand layer, the hanging shaft method is preferable because it can be more accurately controlled and held to alignment. If, subsequently, it should be found impossible to hold the shaft because of excessive weight or pull, it may be cut loose from the bearers and continued as a drop shaft.

In one instance of this kind where ten 2-in. hanging bolts were used and four long, welded auxiliary bolts of the same diameter were carried down the corners of the shaft, nuts and washers pulled through the 12x12-in. shaft timbers and hanging bolts broke under the strain. As it was impossible to hold the shaft to the bearers and it was not far to ledge, the remaining bolts were cut close under bearers and the shaft was completed as a drop shaft. The shoe was advanced by jacking as before, assisted by the weight now resting on it, and timber was placed at the top as the whole shaft timbering settled. After being ledged, this shaft was realigned from surface and served the mine as a hoisting shaft for fifteen years. This measure, however, is recommended only as a last resort. There is always the danger that the shoe may be held up by boulders or very hard material under one side while the other still rests on soft ground, thus tending to deflect it from vertical. Realigning a shaft, through the quicksand portion, is very difficult until the water has drained off and the sand has become dry.

The shaft location having been selected and staked out, the first thing to be done (if the hanging shaft method is followed) is to place adequate bearers. These may be long, heavy timbers, steel girders, or reinforced concrete. If a heavy layer of quicksand is likely to be encountered, this latter type is often adopted, as the bearers may be made to any desired length and the engineer is assured that, even though there may be movement of the surface around the collar of the shaft, his bearers reach back to permanently solid ground. This is very important, for, frequently, while sinking through the sand layer, the sand at bottom of shaft begins to move or "boil," resulting in holes around the collar. Short bearers might become undermined and, therefore, useless. For a 12x19-ft. shaft where 40 ft. or more of quicksand was expected, 24-in. 115-lb. steel I-beams 40 ft. long placed in pairs and resting on large reinforced concrete mats were used as bearers.

For obvious reasons, bearers are usually placed across the short side of the shaft. Too much care can hardly be exercised in the construction of properly placed bearers, because in a hanging shaft they must carry the load until a suitable point is reached in the shaft for placing secondary bearers. This may not occur until the ledge is attained. If necessary, one or more sets of timber may be added above the bearers to bring the shaft collar up to the desired elevation.

A 6-ft. shoe and skirting in place in shaft, ready for jacking down into quicksand which is just below bottom of shoe. Part of skirting extends up into shaft behind last set of timber

When sinking has begun, the first set of timber is placed tight up under the bearers followed by a set with such length of studdle (from 2 to 5 ft.) as is deemed advisable for local conditions, both sets being held by hanging bolts running through the bearers in openings left for the purpose. Succeeding sets are hung from this second set in the usual manner. The greater the weight anticipated, the shorter the studdle and the more and larger hanging bolts required.

While passing through no worse ground than dry sand, gravel, clay, or similar material, progress is rapid and the engineer is inclined to imagine that much of his careful and expensive preparation for expected difficulties was unnecessary. It is very important, however, that he does not allow this feeling to induce any negligence or carelessness in the blocking and wedging of each set as he proceeds. "Nature abhors a vacuum" and she is sure to take prompt measures for filling one left behind shaft timbers. Any voids left back of the sets on the way down are bound to cause additional trouble when the quicksand, which was the reason for his elaborate precautions, is reached. Consequently it is wise, unless the ground is very firm and self-supporting, to "back-lath" as he excavates.

Back lath are simply shoring plank placed around the sides as room is made for them. They are put sufficiently far back so that the regular sets and lath may, later, be placed inside of them. All the space between ground and back lath and between back lath and set is tightly blocked to prevent any sluffing or moving of the ground. This cannot be emphasized too strongly. Two-inch fir plank is ordinarily used on the Mesabi for the regular or inside lath and cedar lagging and tamarack poles are used for blocking.

When the shaft is almost down to the quicksand layer, and because it is important to know definitely at just what point this is to be encountered (unless this has been accurately determined), a small pilot shaft or test pit should be kept in advance of the main shaft. The chief reason for this is that the engineer may be certain to leave sufficient room between the last set placed in the shaft and a point at least 2 ft. above the wet quicksand for assembling the shoe and its skirting. This space must be very carefully back-lathed and spragged to prevent any possible movement of ground while the shoe is being put in place. The engineer must be positive that plenty of room has been left inside the back lath for this purpose as well as the vertical distance mentioned in the foregoing. One of the photographs shows a 6-ft. shoe and a 6-ft. skirting just after being placed in the shaft, ready to sink in the quicksand that lies about 2 ft. below the bottom of shaft.

The shoe itself is made up in four sections and, before it is taken down into the shaft, has been assembled (and subsequently disassembled) at the shop to remedy any faulty construction that might cause difficulty in joining up the sections in the restricted room of the shaft.

When all four sections of the main shoe have been placed in correct position and leveled up, they are bolted and riveted together, the skirting is added above it, and the shoe is filled with concrete with an oak timber all the way around the top to serve as a jacking plane. The level should be used constantly all the way down, because, if the shoe is permitted to deflect from vertical, it is difficult to bring it back. An ounce of prevention here may be worth many pounds of cure.

Inasmuch as we know that, behind the shoe and its skirting, we have dry ground that has been well back-lathed, we may put in one more set in the usual manner (with studdles and hanging bolts) before beginning the solid

timbering that is used through the quicksand. This solid timbering consists of alternate sets of 12x12-in. and 6x8-in. timber, leaving room for hanging bolts to be placed from one 12x12-in. to the next and in front of the narrower sets. These hanging bolts are straight bolts (not hooked) and are put in from below. One must be careful, however, to leave room between the last set placed and the jacking plane of shoe for the jacks that will be used for forcing the shoe down. The jacks, when closed, are about 20 in. high and, with their blocks, will require two feet of room. The number of jacks needed will depend on the size of shaft and the density of the ground. In the shaft mentioned, some thirty were used. After the shoe and skirting have been put in position, all sets from that point on are placed inside the skirting and close against it.

Ready, now, to jack the shoe down into the quicksand, it is best to do only enough digging to permit the shoe to move, loosening the material around its cutting edge cautiously and working uniformly all the way around, keeping all the jacks tight and the shoe advancing evenly.

For the first few feet, until the shoe is well submerged in the sand, it is best not to hoist much dirt but to throw it back in the shaft where it helps to hold the sand in place. The rule should be to dig only enough to permit the shoe to be jacked ahead, progress being measured, not by the number of skips of sand hoisted but by the advance of the shoe and the sets placed.

What the miners term "boiling" in the bottom of the shaft is caused by a movement of ground around the outside of the shaft, down under the shoe and up through the sand bottom. This boiling must be checked as soon as it appears, because, if it is allowed to continue, one could hoist busily for days and have nothing to show for his work but a large hole around the shaft collar.

It is well to keep several bales of fine meadow hay on hand, as experience has shown that nothing else is so quickly effective for stiffening up the quicksand so that digging may be continued. At the first indication of boiling at any spot, the hay is forced down at that point, using a chisel-edged bar 4 to 6 ft. long (easily made in the mine shop) and pushing the hay down as far as possible. It may sometimes be necessary to spend hours at a time filling the sand with hay to a depth of 3 or 4 ft. before digging is resumed. Even during such periods, however, the jacks should always be kept tightened, as this very boiling process often loosens the ground sufficiently to permit the shoe to advance appreciably, perhaps enough to cut off the movement of sand. The deeper the shoe can be forced ahead of digging, the less is boiling likely to occur. And since boiling *always* means a movement of ground from around the outside of the shaft, it must be held to a minimum or trouble is sure to result. Even a shoe 6 ft. in. depth may be entirely submerged in quicksand from cutting edge to jacking plane and still show this boiling.

In one shaft, put down through quicksand, the first intimation the miners had of anything wrong was when gravel began to drop down the shaft. Investigation disclosed that just below the collar a void had been caused by repeated boiling in the bottom (more than 100 ft. lower), the lath had dropped back into the hole thus formed, and gravel fell from this space, endangering the lives of the men working in the shaft. If ground movement of this kind is not quickly controlled, the drag on the timbers will soon wreck the shaft.

Numerous plans were devised with the idea of draining the wet sand in advance of the main shaft, but the one which was most effective was the use of a small shoe (4x4 ft. over all) that was jacked down in the center of the shaft ahead of the main shoe, forming a pilot shaft of that size. As this small shoe was jacked down, sets of 6x8-in. hardwood were added at the top and jacking was continued, only a sufficient amount being dug inside the pilot shaft to permit the small shoe to move. This pilot shaft also provided a sump from which to keep the shaft unwatered and was sunk 6 to 12 ft. in advance. Just as in the main shaft, care must be exercised to avoid boiling, which might result in undermining the main shoe and shaft.

The inclination of almost every miner, particularly men without experience in quicksand, is to dig too much. It must be impressed upon them to dig only when the shoe can not otherwise be jacked ahead and not even then if boiling should result.

Thus it will be seen that sinking successfully through quicksand requires a combination of caution, patience, and care, but coupled with a willingness to decide quickly when necessary and to take the long chance when that seems the only way out.

If boulders impede the progress of the shoe they should be pushed aside with bars if possible. If this cannot be done, careful blasting must be resorted to, using every available means of avoiding damage to the cutting edge of the shoe.

If quicksand extends to the ledge, the engineer should not attempt to remove the back plates of the shoe and it may be advisable to leave the entire shoe in place, using it instead of timbers for the space it occupies. In one case where this was done, and after the shaft had advanced a few feet into solid rock, the shoe and first set below ledge were faced with concrete, thus sealing off the joint between sand and rock and protecting the steel plates of the shoe from corrosion.

The same care that has been exercised through the quicksand must be continued until the shoe is well sealed into the ledge and there is no opening left for sand to escape into the shaft.

Carefulness first, last, and all the time, and by every man employed in the shaft, must be uppermost in mind from the laying of bearers to ledge. Carelessness here provides its own speedy penalty.

There will be days when progress is measured only by inches, but the engineer must not allow this to persuade him to remove sand from the shaft so rapidly that boiling is induced. He must be patient and watchful, and he will be rewarded by better and safer progress when the danger has been passed.

The shoe used in sinking through quicksand has been first assembled on surface at the shop so as to allow any structural defects to be remedied before it is taken down the shaft, where the space is cramped. It is then again disassembled. The skirting is not in place in the picture

FLOTATION OF MERCURY ORES

Awaits Favorable Differential as Compared With Furnacing

Recent tests with selective concentration indicate its feasibility

Lyman H. Shaffer, Joseph Newton, and A. W. Fahrenwald

PRODUCTION of quicksilver in the United States in 1937 amounted to 16,508 flasks[1] valued at $1,488,691[2]; in the same year, 18,917 flasks were imported. The domestic production in the year cited came from 101 producing mines, and principally from low-grade ores. In 1925,[3] the average tenor of domestic mercury ores was 0.50 per cent, and by 1934 it had dropped to 0.41 per cent. This gradual decrease has continued, and the average tenor of domestic ores at present probably is about 0.35 per cent.

Concentration of mercury (or quicksilver) ores has never had widespread application, but the facts cited with regard to the decrease in grade of domestic ores indicate that concentration is likely to become more important in the future. For this reason, the studies here reported were made.

The flotation process seemed to offer the best possibilities for the following reasons:

1. Cinnabar floats readily, and, of course, is by far the most important ore mineral of quicksilver.

2. Most quicksilver ores are low in grade, and the cinnabar tends to slime badly on grinding. These facts would make the application of gravity methods difficult in spite of the high specific gravity of cinnabar, which is 8.0.

3. There was the possibility of using selective flotation technique to separate the cinnabar from minerals which would interfere with subsequent furnacing or retorting of the flotation concentrate.

As the investigation proceeded, two principal subjects were studied: (1) the flotation properties of cinnabar itself, and (2) the separation of cinnabar from arsenopyrite by flotation.

Ores Used—Ore No. 1 was from the Mirabel mine, in Lake County, Calif., and represented a common type of quicksilver ore. The gangue was largely serpentine, and the head assay was about 0.33 per cent quicksilver. Cinnabar was the only sulphide mineral present.

Ore No. 2 was from the Yellow Pine district, in south-central Idaho. This was a hard siliceous ore containing cinnabar and a small amount of stibnite. Its average head assay was 0.90 per cent quicksilver.

Natural ores containing arsenic and antimony in appreciable amounts were not available; synthetic ores were made by adding pure stibnite or arsenopyrite to ore No. 2.

Crushing and Grinding—All ore was crushed to minus $\frac{3}{8}$ in. and then ground dry in a small pebble mill or rod mill to pass a 100-mesh screen. This minus 100-mesh material was thoroughly mixed and samples were weighed out from it for the batch flotation tests. Ore No. 2 responded nicely to flotation, and in all the tests made the recovery of mercury ran between 95.0 and 99.65 per cent, both on the natural ore and on the artificial ores made by mixing arsenopyrite or stibnite with ore No. 2. Recovery of mercury from ore No. 1 was not nearly as good; the recoveries in batch tests ran between 64.0 and 88.0 per cent. This appeared to be due to the facts that the serpen-

Table I—Effect of pH on the Recovery of Cinnabar

10-gram flotation charge in small cell
Ore No. 2 (Yellow Pine)
Reagents: Amyl xanthate (Great Western Z-5) ..... 0.2 lb./ton
Sodium silicate ..... 1.0 lb./ton
Pine oil (acid circuit) ..... 1.8 lb./ton
(alkaline circuit) ..... 3.6 lb./ton
pH regulated with sodium carbonate or nitric acid

pH	Tailing		Concentrate		Recovery, Per Cent (From Calculated Heads)
	Weight, Grams	Hg Assay, Lb./Ton	Weight, Grams	Hg Assay, Lb./Ton	
5.0	7.890	0.698	2.110	71.00	96.5
5.5	8.260	0.494	1.740	89.12	97.4
6.0	7.642	0.226	2.358	65.10	99.0
6.5	8.101	0.762	1.899	78.35	96.0
7.0	7.799	0.550	2.201	68.50	97.3
7.5	6.614	0.438	3.386	44.80	98.1
8.0	7.180	0.684	2.820	53.25	96.8
8.5	7.898	0.796	2.102	70.80	96.0
5.7 (*a*)	7.850	0.199	2.150	71.4	99.0
6.9 (*a*)	8.006	0.775	1.994	74.6	96.0
7.2 (*a*)	8.100	0.498	1.900	79.5	97.4

(*a*) pH measured on tailing water after test. The pH values of the other tests were obtained by testing the solution containing the reagents before the ore was added.

Table II—Effect of Soluble Starch and Sulphuric Acid on the Recovery of Cinnabar

500-gram charge in Sub-A machine (with soluble starch)
300-gram charge in Sub-A machine (with H_2SO_4)
Ore No. 1 (Mirabel)
Reagents: Amyl xanthate (Z-5) ..... 0.07 lb./ton
Pine oil ..... 0.25 lb./ton
Starch and H_2SO_4 as indicated below

Soluble Starch, Lb./Ton	H_2SO_4 Lb./Ton	Tailing		Concentrate		Recovery, Per Cent
		Weight, Grams	Hg Assay, Lb./Ton	Weight, Grams	Hg Assay, Lb./Ton	
0.6	....	9.892	217.2	490	0.885	83.2
1.2	....	8.373	248.4	492	1.234	70.0
2.4	....	8.735	129.0	491	1.610	58.7
...	0.05	5.941	128.0	294	0.885	68.5
...	0.10	4.951	229.2	295	1.600	64.6
...	0.67	4.790	271.2	295	1.070	80.5
...	2.00	6.927	180.8	293	1.940	67.5

The three authors are, respectively, graduate student in metallurgy, assistant professor of metallurgy, and professor of metallurgy, at the Idaho School of Mines, Moscow, Idaho.

tine gangue slimed badly and that the serpentine and cinnabar were intimately associated. A special test made on this ore by grinding in a rod mill to diminish the amount of slimes, and then regrinding and refloating the first flotation tailing, gave a total recovery of 93.0 per cent; the best ever attained with this ore.

Flotation—All flotation tests were made in either a 500-gram Denver Sub-A batch machine or in a small pneumatic cell which took a 10-gram charge. The pneumatic cell was the same as that described in a previous article[4]. In most cases, a charge of 300 grams of ore was used in the Sub-A machine in order to give a more dilute pulp in the cell. Previous work[5] has indicated that a low pulp density is advantageous in the flotation of ores containing slimes.

Flotation of Cinnabar—The accompanying tabulations of the various flotation tests were made to determine the floatability of cinnabar; a brief explanation is given for each table.

Data in Table I are shown graphically in Fig. 1. The solid line is obtained by plotting initial pH of the solution (before adding the ore) against recovery; the broken line represents the pH of the tailing water plotted against recovery (last three tests). Recovery is good in all cases (from 96.0 to 99.0 per cent), but there is a definite minimum near the neutral point, with a maximum on each side. This study seems to indicate that a slightly acid pulp (pH, 5.5 to 6.0) gives the best recovery of cinnabar; also, less frother is required in the acid pulp.

Fig. 2 shows graphically the data in Table II. It was thought that the soluble starch would improve recovery and grade of concentrate because of its dispersing action on the serpentine slime, but this was not the fact. Recovery decreased as the amount of starch increased, and the grade of the concentrate was quite low at the highest concentration of starch. Sulphuric acid, however, showed a maximum recovery in a slightly acid pulp (about 0.8 lb./ton), indicating the same trend as that shown in Fig. 1. The test with 0.67 lb. per ton of H_2SO_4 also produced the highest grade concentrate of any in this series.

Data from Table III are plotted in Fig. 3. The cationic reagent did not improve the recovery over that with pine oil alone; the anionic reagent actually decreased it slightly. Both, however, lowered the grade of the concentrate. Note that on this ore No. 2 pine oil alone will give a 96.3 per cent recovery of the mercury.

Table IV represents the results of a series of determinations designed to find the best collector to use for these ores. By the use of pine oil and xanthate only, it was possible to secure a 96.8 per cent recovery on ore No. 2 (with Z-5 xanthate) and an 88 per cent recovery on ore No. 1 (with Z-6 xanthate).

The grade of concentrate in Test **a** was quite high, but in Test **b** it was low because a long frothing time was used to bring up as much cinnabar as possible. It will be noted that the grade of concentrate obtained in different tests varies over a wide range for both ores. This is to be expected because both ores were low in grade and the primary aim of these tests was high recovery rather than the production of high-grade concentrate. Moreover, these tests were all batch tests, so that the concentrate was really rougher concentrate. It was felt that the problem of producing a commercial grade concentrate would not be difficult if good recoveries could be

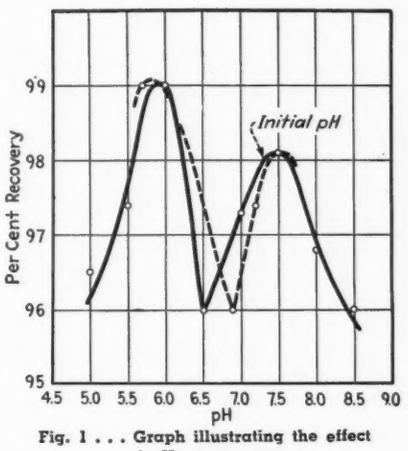


Fig. 1 . . . Graph illustrating the effect of pH on recovery

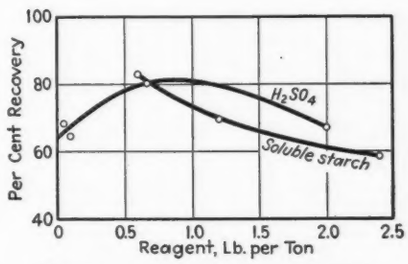


Fig. 2 . . . Effect of different reagents on the flotation of cinnabar with 0.07 lb. amyl xanthate (Z-5) per ton and 0.25 lb. pine oil per ton

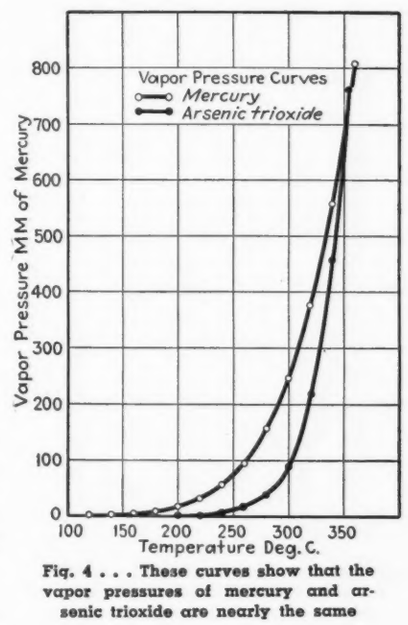


Fig. 4 . . . These curves show that the vapor pressures of mercury and arsenic trioxide are nearly the same

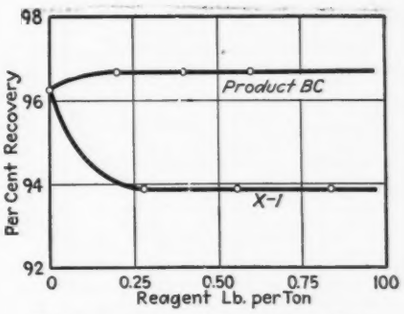


Fig. 3 . . . Curves indicating the effect of cationic reagent (Du Pont Product BC) and anionic reagent (X-1) on the flotation of cinnabar

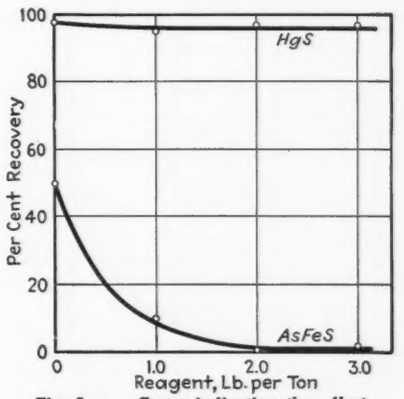


Fig. 5 . . . Curve indicating the effect of lime on the flotation of cinnabar and arsenopyrite with 0.1 lb. amyl xanthate (Z-5) per ton and 0.35 lb. pine oil per ton

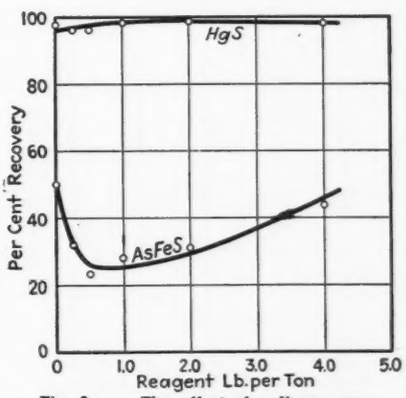


Fig. 6 . . . The effect of sodium cyanide (NaCN) on the flotation of cinnabar and arsenopyrite with 4.2 lb. amyl xanthate (Z-5) per ton and 0.35 lb. pine oil per ton

made. Only one preliminary test was made on cleaning a concentrate from ore No. 1. This produced a concentrate assaying almost 1,000 lb. of mercury per ton.

Finally, a test was made to determine the maximum possible extraction from ore No. 1 (Mirabel) by rod-mill grinding and flotation, followed by regrinding and reflotation of the tailing. These data are given in Table V.

Flotation of Cinnabar and Stibnite.—Only a few tests were made on the artificial ores containing cinnabar and stibnite, and these were made primarily to see if the presence of stibnite would in any way hinder the flotation of cinnabar. No effort was made to prevent the stibnite from floating with the cinnabar. Results are shown in Table VI.

Table VI shows that the recovery of cinnabar seems to be uneffected by the presence of small amounts of stibnite. Recovery of cinnabar is especially good in an acid pulp, but considerably lower in an alkaline pulp, as was expected. Recovery of the stibnite was about the same in both cases (76.5 and 73.8 per cent).

Antimony sulphides should not interfere too seriously with the subsequent furnacing or retorting of a cinnabar concentrate. In the first place, the oxides of antimony condense at higher temperatures than does mercury, so that it should be possible to separate the two in the condenser system, if they vaporized together; by controlling the temperature, the antimony could be condensed in the first (hottest) portion of the condenser, and the mercury recovered in the cooler section. Moreover, it is possible to separate mercury from antimony by carefully controlling the temperature and air supply to the furnace, so that only the mercury distills, and the antimony is retained in the furnace residue. This process [6] has been successfully developed to treat a flotation concentrate containing about 7.7 per cent Hg and 26.4 per cent Sb; moreover, the mercury in this concentrate is in the form of livingstonite, $HgS.2Sb_2S_3$, and it is probable that this would present more difficulties than would a simple mixture of mercury and antimony sulphides.

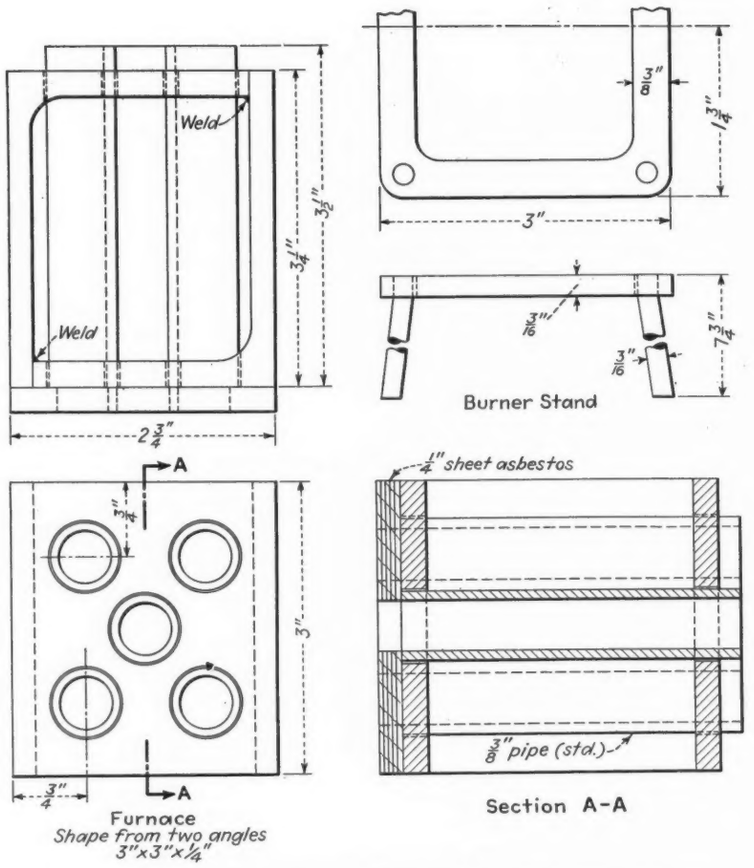


Fig. 7 . . . Details of construction of furnace used for making mercury assays

Flotation of Cinnabar and Arsenopyrite.—Arsenic in a mercury concentrate would be a more serious problem than antimony, for it would be difficult to prevent the oxidation and volatilization of the arsenic, and the arsenic trioxide would condense with the mercury. The vapor pressures of mercury and arsenic trioxide are nearly the same, as may be seen by the curves in Fig 4.[7] Consequently, it seemed desirable to try to find reagents that would depress arsenic minerals while permitting cinnabar to float. An artificial ore containing arsenopyrite was made up and a number of flotation tests were made. Of all the reagent combinations tried, lime gave the best results, almost 100 per cent rejection of the arsenopyrite and better than 95 per cent recovery of the cinnabar. Sodium cyanide also depressed the arsenopyrite, but not as effectively as lime. The data for flotation with lime are given in Table VII and Fig. 5; data for cyanide in Fig. 6. Arsenopyrite was the only arsenic-bearing mineral investigated.

Sampling and Assaying.—Sampling

Table III—Flotation of Cinnabar With Cationic and Anionic Reagents

10-gram charge in small cell
Ore No. 2 (Yellow Pine)
Reagents: Pine oil ..... 0.3 lb./ton
DuPont Product B. C. (cationic reagent)..... Amounts as
DuPont Reagent X-1 (anionic reagent)..... noted below

B. C., Lb./Ton	X-1, Lb./Ton	Concentrate Weight, Grams	Concentrate Hg Assay, Lb./Ton	Tailing Weight, Grams	Tailing Hg Assay, Lb./Ton	Recovery, Per Cent
0.00	0.00	2.442	101.0	7.558	0.502	96.3
0.20	....	2.562	40.0	7.438	0.473	96.7
0.40	....	2.420	42.2	7.580	0.474	96.6
0.60	....	2.693	38.1	7.307	0.479	96.7
....	0.28	1.330	74.8	8.670	0.750	93.9
....	0.56	1.560	63.8	8.440	0.767	94.0
....	0.84	1.830	54.3	8.170	0.795	93.8

Table IV—Conditions Which Gave the Best Recovery of Cinnabar in Batch Tests

a 300 grams of Ore No. 2 (Yellow Pine)
Sub-A machine
Reagents: Amyl xanthate (Z-5).. 0.10 lb./ton
Pine oil..... 0.42 lb./ton

b 480 grams of Ore No. 1 (Mirabel)
Sub-A machine
Reagents: Pentasol Xanthate No. 2..... 0.20 lb./ton
Pine oil..... 0.36 lb./ton

Test	Concentrate Weight, Grams	Concentrate Hg Assay, Lb./Ton	Tailing Weight, Grams	Tailing Hg Assay, Lb./Ton	Recovery, Per Cent
a.....	15.753	417.6	284	0.80	96.8
b.....	60.0	35.2	420	0.695	88.0

and assaying of mercury ores must be considered together; since errors in one affect the results of the other, it is essential that both be accurate if a true value of the mercury content of a given sample is to be determined. The weight of the ordinary assay sample is one-half a gram, and it is imperative that this shall be a true sample of the entire mass—something that is often difficult to attain. Samples for assaying were always taken by the cone-and-quarter method and the final sample was taken from a mass of ore not exceeding five grams. In most of the flotation tests the concentrates and tailings were assayed and the head assay was calculated. Low-grade tailings and head samples were run with multiple samples. At least six one-half gram charges were taken and the mercury distilled from these was combined before titration. A 1/400 normal thiocyanate solution was used for titrating on tailing and head assays, and a 1/10 normal solution for concentrate assays. Both solutions were standardized against triple distilled mercury and pure silver.

The Bureau of Mines method[8] for determination of mercury was used for all assays. It was modified to the extent of using individual test tubes for each assay, breaking off the portion containing the roasted ore each time and pouring hot nitric acid through the tube. This procedure is more rapid and convenient than the original method as outlined by Bouton and Duschak. The furnace was made by welding two short pieces of angle iron together in the form of a box with open top and bottom. The furnace tubes were made of $\frac{3}{8}$-in. pipe cut slightly longer than the outside dimensions of the box and inserted in holes drilled in both the front and back of the furnace proper. The furnace was heated with a Meker burner. Fig. 7 shows the details of the furnace construction.

Conclusions follow:

1. Cinnabar is readily floatable with a rather wide variety of reagent combinations, although the best results seem to be obtained with a slightly acid pulp. Xanthates improve the recovery of cinnabar, but over 95 per cent could be recovered from ore No. 2 by the use of pine oil alone. The greatest impediment to the flotation of cinnabar appears to be the presence of gangue slimes in the ore.

2. Successful application of concentration to mercury ores will come only when this method is cheaper than direct furnacing. The cost of grinding the ore will undoubtedly be the major factor to be considered, and the present study seems to indicate that (a) rod mills should be used rather than pebble or ball mills to avoid sliming, and (b) a unit flotation cell should be installed in the rod mill-classifier circuit to scalp off the cinnabar as soon as it is liberated.

3. The use of lime appears to offer a means of effectively depressing arsenopyrite without affecting the flotation of cinnabar.

Table V—Flotation of Cinnabar From Ore No. 1

Reagents: Primary flotation
- Z-5 xanthate ..... 0.10 lb./ton
- Sodium silicate ..... 0.20 lb./ton
- Pine oil ..... 0.40 lb./ton

Secondary flotation
- Z-5 xanthate ..... 0.07 lb./ton
- Sodium silicate ..... 0.54 lb./ton
- Pine oil ..... 0.25 lb./ton

Product	Weight, Grams	Hg Assay, Lb./Ton	Recovery, Per Cent
Heads	300.	4.33	....
First concentrate	9.499	108.0	79.0
First tailing	290.5	0.95	....
Reground tailing	283.	0.95	....
Second concentrate	12.01	14.76	14.0
Second tailing	271.00	0.338	7.0
Total recovery			93.0%

Table VI—Flotation of Cinnabar and Stibnite

300 grams of ore made by adding 10 grams of stibnite ore to 290 grams of ore No. 2.

Test **a**: Reagents:
- Z-5 xanthate ..... 0.10 lb./ton
- Sodium silicate ..... 0.13 lb./ton
- H_2SO_4 ..... 0.30 lb./ton
- Pine oil ..... 0.35 lb./ton

Test **b**: Reagents:
- Z-t xanthate ..... 0.10 lb./ton
- Sodium silicate ..... 0.13 lb./ton
- Lime ..... 4.0 lb./ton
- Pine oil ..... 0.35 lb./ton

	Head		Concentrate		Tailing			Recovery, Per Cent	
Test	Weight, Grams	Sb Assay, %	Weight, Grams	Hg Assay, Lb./Ton	Weight, Grams	Hg Assay, Lb./Ton	Sb Assay, Per Cent	Hg	Sb
a	300	0.467	10,381	329.6	290	0.039	0.11	99.65	76.5
b	300	0.467	20,612	228.0	279	4.33	0.12	71.2	73.8

Table VII—Flotation of Cinnabar and Arsenopyrite With Lime

300 grams of ore (Ore No. 2 + arsenopyrite)
Sub-A machine
Reagents:
- Z-5 xanthate ..... 0.10 lb./ton
- Sodium silicate ..... 0.35 lb./ton
- Pine oil ..... 0.35 lb./ton

	Heads		Concentrate		Tailing			Recovery, Per Cent	
CaO Lb./Ton	Weight, Grams	As Assay, Per Cent	Weight, Grams	Hg Assay, Lb./Ton	Weight, Grams	Hg Assay, Lb./Ton	As Assay, Per Cent	Hg	As
1.0	300	1.63	13.167	252.0	286	0.590	1.63	95.1	10.16
2.0	300	1.63	6.688	486.0	293	0.379	1.66	96.8	0.41
3.0	300	1.63	14.798	244.8	285	0.463	1.39	96.5	1.90
0.0	300	1.63	7.581	788.8	211	0.408	1.15	98.0	49.75

REFERENCES

[1] One flask contains 76 lb. 1 oz. of mercury.

[2] Minerals Yearbook, U. S. Bureau of Mines, 1938.

[3] Minerals Yearbook, U. S. Bureau of Mines, 1935.

[4] "Laboratory-size Pneumatic Flotation Cell," by Ernest Oberbillig and A. W. Fahrenwald; *The Mining Journal*, Vol. 22, No. 1, May 30, 1938.

[5] "Pulp Density as a Factor in Flotation," by Joseph Newton and A. O. Ipsen; *E. & M. J.*, Vol. 139, No. 5, May, 1938.

[6] "Reduction of Livingstonite Concentrate," by H. B. Menardi. A.I.M.E. T. P. 1042, Metals Technology, February, 1939.

[7] Data from International Critical Tables, Vol. 3, McGraw-Hill Book Co., New York.

[8] "The Determination of Mercury," by C. M. Bouton and L. H. Duschak; U. S. Bureau of Mines T. P. 227, 1920.

▼ ▼ ▼

Manganese in Gold Coast Colony

THE African Manganese Company, Ltd., is the only company engaged in mining manganese ore in Gold Coast Colony. It operates at Nsuta, near Tarkwa, in the Wasaw-Aowin District, Western Province. Ore exported during the year 1938–39 totaled 257,378 dry tons valued at £681,188, compared with 532,126 dry tons, valued at £1,166,175, in the previous year, a decrease of 274,748 dry tons and £484,987 in value, according to the report of the Mines Department just received. The decrease in exports was due to world market conditions.

The daily average number of persons employed was 42 Europeans and 1,065 Africans, as compared with 46 Europeans and 1,203 Africans in the previous year. A fixed aerial cableway of 100 tons per hour capacity for ore stacking purposes was completed and brought into operation.

A Survey of Wire-Rope Practice Yields Interesting Facts

Opinions of various operating men and engineers as to the relative merits of preformed and ordinary types of construction are summarized

F. S. McNicholas
Assistant General Superintendent
Climax Molybdenum Company
Climax, Colo.

▶ THIS ARTICLE HAS BEEN WRITTEN *in an endeavor to sum up and coordinate the opinions and experience of various Western mine operators and several rope engineers, as well as of the author, in the use of preformed and non-preformed wire rope.*

PREFORMED ROPE is defined as that type in which each strand and the wires of each strand are pre-shaped by a patented method into the exact helical form which they will assume in the finished rope. It was first made in 1924. The preforming operation removes practically all of the torsional or untwisting forces ordinarily encountered in non-preformed wire rope. In non-preformed rope, in contrast, all the wires are laid by force into a strand and then the strands are laid by still greater force into the completed rope.

The average experience and practice at this time in respect to these two different types of wire-rope construction in metal-mining use is indicated in the following detailed comparison of the respective rope characteristics:

Tests run by certain engineers to determine the metallic fatigue caused by bending show that preformed rope gives more resistance to such fatigue than does non-preformed, particularly when the ropes are lightly loaded. Other engineers hold that preforming does not increase resistance to fatigue, wear, or abrasion. The average opinion is that preforming does increase resistance to metallic fatigue caused by bending when the rope is working over small-diameter sheaves. Where ropes are intended to work over properly designed sheaves of ample diameter, it would seem that little is to be gained by preforming.

As to flexibility and resistance to kinking, the opinion of those interrogated is unanimous that these are increased by preforming.

Whether or not the load on a preformed wire rope is equally distributed to each strand and to every wire in the strand to a better degree than in non-preformed rope could not be substantiated by the field survey.

Opinion is again unanimous, so far as the survey is concerned, that when the outer wires of preformed rope fracture, they remain more or less in place and do not stand up from the surface of the rope, thereby offering likelihood of injuring workmen and sheaves. The contrary is the case with non-preformed rope.

This feature of preformed rope makes inspection difficult, as it is possible to have many broken wires in one section of rope that could not be discovered by ordinary inspection. For this reason, the survey shows, it is the general practice to use only non-preformed rope for man-cage service.

Where the rope has to be handled much by workmen, or has to be spliced as in slusher work, or where ease and quickness of installation is an important factor, opinion, backed by practice, appears to be unanimous that rope of the preformed type should be used.

In respect to ease of installation, those giving their opinion are in agreement that preformed rope can be handled more easily than non-preformed, and can be installed more easily and more quickly. The advisability of using it is definitely indicated where time of installation is important, as on big electric shovels where loss of running time is expensive. In certain types of work, however, this advantage is not considered worth the additional cost and a preference for non-preformed rope is indicated, although strict procedure and inspection during the "breaking in" period are thought necessary.

Opinion is general, among those approached, that where the ends of rope are fixed, there is little difference in the amount of rotation in sheaves by either type. In work where the rope can rotate, the preformed type appears to rotate less in sheaves than does the non-preformed rope. The preformed rope is likewise easier to socket than the non-preformed. However, perfect socketing of the latter type has been practiced for many years.

The two principal factors that must be considered in selecting the proper construction of wire rope for a given installation are the abrasion that will be encountered by the line and the flexibility that is needed over drums and sheaves. As a general rule the flexibility of a wire rope increases in *direct* proportion to the number of strands in the rope and the number of wires in the strand. Also flexibility is influenced by the type of construction, as indicated elsewhere. Resistance of a wire rope to abrasion is found to be inversely proportional to the number of strands in the rope and the number of wires in the strands. For each individual operation, there is a construction of rope that will give maximum life for both conditions mentioned.

The availability of rope of preformed type may permit the selection of a rope construction that is desirable on other counts but which could not be had in non-preformed rope. For example, the many advantages of the Lang lay are known to most users of wire rope. These advantages may be utilized, in certain instances (as in slusher operation) by the use of Lang-lay preformed rope where it is impossible to use Lang-lay non-preformed rope.

In passing, I would point out that the socalled "Tru-Loc" fittings can be used only on preformed rope.

Inasmuch as preformed rope costs 20 to 25 per cent more than non-preformed, superior performance of preformed rope is necessary to justify its use.

Recommended practice as to which of the two types of wire-rope construction should be used for given applications is summarized as follows:

Shallow shaft hoisting, man and ore—Use only regular-lay non-preformed wire rope, due to the ease and thoroughness with which inspection can be made and to the fact that this type is more elastic. Do not use pre-

formed or Lang-lay rope under the conditions noted; it lacks elasticity.

Deep shaft hoisting—For man-cage service use either Lang-lay or regular-lay non-preformed rope; because of the ease and thoroughness possible in inspecting it. For ore hoisting Lang-lay non-preformed rope is generally used, although preformed rope may be used.

Scraping (slushing)—Use only preformed rope, because of the ease of handling and splicing afforded and its freedom from barbs.

Shovel work or work where ease of installation is of importance—Use preformed rope.

Work where Lang-lay is indicated to secure maximum life, and where rope is not fixed, or where sheaves and drums are not properly designed—Use preformed rope.

Service of handling men, or where there is danger to life or property from rope failure—Use non-preformed rope.

Where maximum elasticity is needed—Use regular-lay non-preformed rope.

Thanks are due several Western operators and several rope engineers for assistance given in the collection of data for this article.

▶ THE FOLLOWING PARAGRAPHS *present two additional case studies of wire-rope practice in the mining field that were made recently by a member of the McGraw-Hill staff in the course of an extensive trip through various producing districts.*

IRON ORE MINE—The rope used most is 1½-in. improved plow steel, 6x21 Lang lay, with hemp center. This is used in skip hoist work, where loads are heavy and speeds high. Lang lay is used because the rope overlaps on the drum, and with this lay about two-thirds more area is exposed on the crown wires, which increases the resistance to abrasion required when one layer coils upon another. On cages the company operating the mine uses 1½-in. and 1⅜-in., 6x19 regular-lay plow steel with hemp centers. The cages are used for handling both men and materials, and the ropes are not subject to such hard service as on the skips, so that they last longer and in some cases the rope has to be removed before it is worn out, on account of safety regulations.

On dragline scrapers used underground, the rope used represents more money value in a year's production than the hoisting ropes. When this system of scraping was first introduced to do away with hand shoveling, 6x37 plow-steel rope was used, but it was soon found that the wires were too small to withstand rough usage. The mine then went to 6x19 plow steel, Seale construction, but with independent wire-rope center, and is still using this. The sizes used are ½ in. and ⅝ in., being wound on small drums holding from 200 to 350 ft., with rough winding on the drums and no attention paid to laying it on in tiers. The abrasion contributes toward short life, as there is considerable dragging on the ground. In this connection considerable difference of opinion exists as to the value of preformed vs. regular wire rope, the talking point for the preformed being that it does not "porcupine," and therefore is less likely to injure the man's hands when strand wires break. This particular mine, however, has not experienced trouble in this respect.

The master mechanic of this mine states that no preformed wire rope has ever been used for hoisting in this establishment. The hoist engineers have run preformed and regular lay ropes side by side on underground slusher hoists, and so far as could be determined, very little difference in life has been observed. Referring to inspection and lubrication, he states:

"The most important thing about wire rope inspection is to be familiar with conditions in the shaft where the rope is used, so that you can put your finger on the sore spot of the rope, and then unless something unforeseen happens in the form of kinks, etc., a person can keep track of rope conditions pretty well. Our ropes here are inspected weekly with the exception of the ends of ropes attached to skips, which are inspected daily.

"The lubrication of hoisting ropes at this property at present is not a great problem. Our main hoisting shaft is vertical, and the only contact the rope has in traveling up and down is at the head and idler sheaves. Our present practice is to pull the skips in the dump so as to get the most of the rope on the drum; leave the rope on the drum long enough so that the outside of the rope gets dry; and paint the rope lubricant on with a large brush."

The following table gives the record of five typical shaft hoist ropes on this property, all being of 1½-in. diameter, of improved plow steel, 6x19, left Lang lay, and hemp center construction; length of each, 4,200 ft.:

Rope No.	Tons Carried Before Turning	Tons Carried After Turning	Cost per Ton
1	248,793	565,422	$0.0048
2	315,943	941,139	0.0028
3	361,544	813,120	0.003
4	548,610	793,066	0.004
5	356,072	879,129	0.0036

Coal and Metal Mining Company—This organization recently totaled its wire rope length in service (about ½ in.) and found about 60 miles in regular operation. The greater part of this rope is non-preformed, although some preformed rope is used on boom hoists, small tuggers, room hoists, rotary dump, and derrick booms in diameters of from ¼ in. to ⅝ in. inclusive. On machinery subject to rough service and abrasive conditions independent wire-rope centers are widely used, but on hoists for shaft and slope work, hemp centers are common. Improved plow-steel rope is used on heavy dragline work and shaft hoists (6x21 construction), and on boom hoists (6x37). Plow-steel rope is used on the tuggers, rotary dump, and car retarders (6x21 right regular lay), with Lang lay on draglines for increased resistance to abrasion.

The average life of 6x37 preformed rope of improved plow steel on car dumpers approximates one year (service fourteen hours per day and five days per week). All wire rope is inspected daily, and this company reports no more difficulty in inspecting preformed rope than regular. Preformed rope is useful where sheave diameters are small in ratio to rope diameter, as resistance to fatigue bending is superior. On large hoists at headframes sheave diameters of 12 ft. to 14 ft. are common, and these give high sheave-rope ratios and long life for rope, other things being equal. The company adds about 3.5 per cent to required ultimate strength in computing rope bending stresses. No trouble from fatigue stresses occurs where the sheave-rope ratios run around 60 to 1 or above. On important hoists resocketing of rope takes place every 90 days.

The company has largely done away with the use of the old type of Warrington construction with large and small wires, because of the tendency of the smaller wires to break. Ropes are replaced on the basis of Roebling charts, according to the amount of reserve strength remaining after service, amount of crown wear, and broken strand wires. Diameter shrinkage is also a cause for replacement. Shaft ropes are lubricated every two weeks. Slope hoist ropes are very difficult to keep lubricated on account of abrasive conditions. In general, other ropes are lubricated every four to five weeks. On hoists a factor of safety of 5 to 6 is used in computing required rope strengths, and ropes are purchased on specifications. The performance of wire ropes is judged on the basis of the showing of the last three ropes used in particular installations. There has been some trouble from the use of Lang-lay ropes, which tend to open up, "birdcage," and loosen under heavy stress so that moisture gets in and causes corrosion.

On a representative 1,500-hp. hoist for shaft work, depth 1,000 ft., 1¼-in. plow-steel rope was used, with 6x25 construction and hemp center. The capacity of each of two cages loaded was 36,000 lb., and including the weight of rope and cage, 46,000 lb. Cylindrical conical drum windings were used, with maximum and minimum diameters respectively 9 ft. and 13 ft. The average rope life, non-preformed, in this service, is about two years.

Morenci pit with the six benches established during 1939 is seen in the distance. Near the headframe is the drill-sharpening shop; below it is the truck-repair shop

Development of Morenci Pit

Material moved in last twelve months includes 9,000,000

John B. Huttl
Assistant Editor

EXCELLENT PROGRESS made in 1939 by Phelps Dodge Corporation in preparing its large open pit at Morenci, Ariz., for production is a tribute to good organization and proper coordination of the many working phases involved in opening up such a large enterprise on the part of the management and the engineering departments. Since my visit late in March last year, approximately 9,000,000 tons of waste rock and 450,000 tons of ore mined for test purposes have been removed, the former figure bringing the total amount of waste handled up to more than 16,000,000 tons since commencement of actual work about two years ago. The total amount of preliminary stripping required to provide for the initial production planned of 25,000 tons of ore a day is estimated at 43,000,000 tons, and current operations are geared to complete the task by Jan. 1, 1942. Waste rock is being removed at a rate of more than 30,000 tons per day, and about 2,100 tons of ore is trucked to the test mill housed in the old Morenci concentrator. Three shifts are worked, floodlights being used to illuminate the various working sites at night.

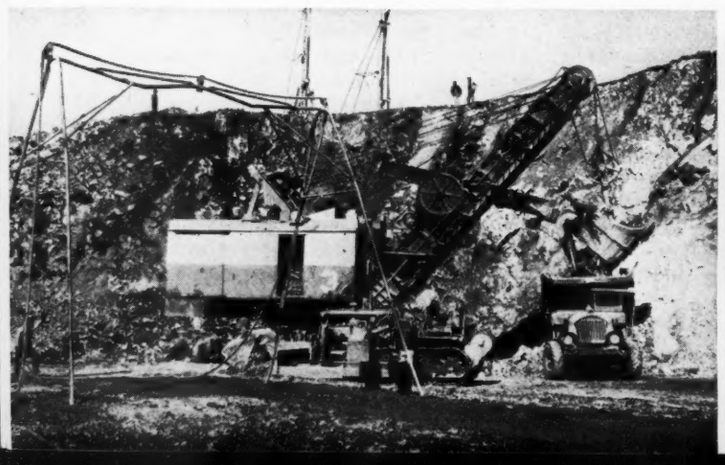
Preliminary development of the open pit consisted both of underground exploratory work and churn and diamond drilling carried on during and following the exploitation of higher-grade sections by block-caving methods. When ready for production, the pit will be more or less elliptical in shape and will be worked on the switchback system. Overburden averages 220 ft. in thickness, and the total height of the ore section is around 850 ft. Waste-ore ratio is approximately 1 to 1, or in round figures mining of the available 230,000,000 tons of 1.06 per cent copper ore will involve stripping of about 230,000,000 tons of waste rock. Adequate dumping areas are available north of the pit, one such site having an estimated capacity of 120,000,000 tons of waste rock, and another will hold an additional 30,000,000 tons. Steep and rugged terrain facilitates dumping of waste materials. In the pit area proper six benches have been established and equipped with 90-lb. rail tracks so far, and rail haulage of broken waste rock will start as soon as dump cars are delivered. The pit had been reached on Feb. 26, 1940, by the main 131-lb. track section, which is being built to connect it with the Morenci terminal and the reduction works site 2½ miles distant.

During the past two years transportation of material derived from general development, preparation of benches and roadbeds, and other similar work have been done exclusively by trucks. This practice will be replaced gradually by rail haulage as tracks reach the different working points, with trucks to remain in the upper part of the pit and at more isolated sites. For truck haulage, grades have been kept below 7 per cent wherever possible, and the maximum haulage distance is 1½ miles.

Drilling falls into two classes, churn drilling and block-and-toe holing. Electric churn drills and in some instances pneumatic toe-hole drills are employed for primary blasting. Churn-drill bits are 9 in. in diameter. On the benches, 50 ft. high, the holes in general are spaced 15 ft. from the crest and 15 ft. apart. The benches are cleaned up to the hard face, which is followed by toe-holing if this is needed to obtain vertical banks for blasting. All drills used in secondary drilling are equipped with detachable bits. The character and hardness of the ground determine the powder charge. Powder varying in strength from 40 to 60 per cent and primed with a 12½-lb. cartridge of gelatine (40 per cent) is used. The charge is detonated by Primacord.

Major haulage equipment currently in operation consists of eighteen trucks of 22½-cu.yd. capacity each on the

One of the earth-moving units in the pit. It comprises a 4½-cu.yd. electric shovel, a bulldozer, and a 22½-cu.yd. truck



The main track, laid with 131-lb. rails, a short distance from the pit entrance. It has been completed to the reduction works site

A closer view of the pit benches, 50 ft. high. The tracks on them are laid with 90-lb. rails

Close-up of a 22½-cu.yd. diesel-driven truck

Proceeds on Schedule

tons of waste rock and 450,000 tons of ore for mill tests

benches and in primary development work, 5-cu.yd. trucks for hauling ore to the test mill, and a fleet of smaller units, some with special body structures, for auxiliary work. The chassis and body of the large trucks are supported by ten wheels fitted with pneumatic tires, and the total weight of the loaded truck is about 65 tons. Mechanical improvements made locally, such as water-cooled brake drums, have resulted in obtaining more economical and dependable service from trucks operated on long hauls and on grades up to 10 per cent. Some units are equipped with 130-hp. diesel engines, which have shown greater efficiency and lower operating costs. Tire mileage has been increased from 8,000 to 13,000. Special equipment includes fuel-supply trucks, grease trucks, repair trucks, sprinkler trucks, and others.

Loading of broken material is done by six 4½-cu.yd. full-revolving electric shovels. These utilize power at 2,300 volts, which is obtained from substations near the loading sites connected to the main power lines carrying 13,000 volts. The complete earth-moving unit—that is, the shovel, bulldozer, and trucks—is operated on a three-shift basis, with portable floodlights and lamps that furnish adequate illumination during the night. Power cables leading to the shovels are carried across roads and railroad tracks via portable steel trestles. Steel blasting shelters are placed at convenient points throughout the pit workings.

As mentioned previously, the main track connecting the pit with the Morenci terminal and the site of the reduction works has been completed. It is about 2½ miles long and has a grade of 0.4 per cent. The track is made up of 131-lb. rails and 8 x 10-in. treated pine sleepers. The switchback system giving access to the upper benches in the pit is laid out so as to have a grade not exceeding 4 per cent, compensated for curvature. Bench trackage consists of 90-lb. rail on 7 x 9-in. untreated sleepers. The tracks leading to the waste dumps are laid mostly on a 0.2 per cent favorable grade, the 90-lb. rails resting on 7 x 9-in. treated sleepers. Although no definite decision has been made in regard to the selection of ore cars, 30-cu.yd. drop-door cars are being considered. As to haulage, four 1,000-hp. diesel-electric locomotives are being tested at the New Cornelia Branch of the company at Ajo, Ariz.

Ore is now being mined in two places in the pit by 1½-cu.yd. diesel shovels and is hauled by 5-cu.yd. trucks to the test mill, which is handling 2,100 tons a day. It is a medium-hard monzonite porphyry with chalcocite. Test work, which has been under way for more than a year, to determine the flowsheet and equipment to be used at the proposed mill, points to three-stage crushing, with vibrating screens in open circuit between the second and third crusher; single-stage grinding; flotation; and filtering in disk-type filters. Final decision, however, is still dependent on the results of an analysis of current operations.

At the site of the reduction works approximately 2¼ miles south of the pit, excavation and foundation work are in progress. Here will be erected a primary and secondary crushing plant and a 25,000-ton concentrator served by the modern machine shops; car repair shops; a warehouse; crushing and bedding plants for the smelter; laboratory and assay office; a modern steam power plant; the smelter; and a large dewatering plant. Tracts of ground large enough to accommodate 300,000,000 tons of tailings are available below the site of the reduction works.

A show place at Morenci is the new model town, locally known as the Stargo townsite. To date 115 houses for 136 families have been completed, with 64 more units, to house 84 families, under construction. The houses include four-room duplex units and five- and six-room dwellings. All are of modern design and construction, with copper piping and copper roofs.

Stargo townsite, show place at Morenci. To date 115 houses for 136 families have been completed, with 64 more units under construction

Here the reduction works will be built. Foundation work is progressing. The site is 2¼ miles south of the open pit

The Recovery of Lode Gold in Jigs

II: Selection and operation of these machines

John M. Hague
Box 522, Uravan, Colo.

THE first question about the installation of a jig is whether the jig will be a profitable investment. This should be carefully investigated before purchasing one, but too often is not. The determining factors are the per cent of the total values which will be recovered in the jig, the differences between the price paid for gold in bullion and for gold in concentrate, the cost of jig operation, and the decrease in tailings value. The first of these may be determined by using the proposed testing method, the second decided after examining smelter schedules, the third (which is dependent chiefly upon the price of the jig) may be estimated closely, and the fourth can be determined by flotation or cyanidation tests on jig heads and jig tailings. An example of such a calculation is given below.

Water—The distribution of water in a mill circuit is another problem which is often important in jig operation. The amount of water which can be admitted through the hutch sometimes limits the size of jig. If too much water is added at the jig, the dilution in the classifier overflow becomes too great and it becomes impossible to overflow the proper size. In the range of pulp dilution used in most mills, the lowering of the pulp density decreases viscosity and hence only small particles are carried over the classifier lip. Aside from classification difficulties, a low pulp density is undesirable in flotation. Recommended hutch water required for jig operation is shown in Table III.

An example of the calculation of water distribution in a mill circuit is given on the opposite page.

Launders—The design of the launders approaching the jig is an important factor usually overlooked. If the pulp flows evenly and slowly without turbulence, the heavy minerals will tend to concentrate in the lower part of the pulp. If this flow continues over the jig bed, without dropping over a step which would disrupt it, the heavy minerals come in contact immediately with the most active part of the bed, and hence may be efficiently treated. If the approach launder and jig bed surface are turbulent, heavy particles may be carried across the jig by a rapid current without being subjected to the action of the bed. The argument that turbulent flow is necessary to prevent loss of gold by surface flotation is not valid. Such a loss can be prevented by a horizontal strip across the approach launder or in the jig itself at the top of the pulp stream to hold back floating particles until they are settled.

Bed—Some operators report an extremely erratic amount of material in the hutch. This is probably caused by a faulty bed. Unless the jig bed is kept active and uniform, it is impossible to secure a satisfactory ratio of concentration. When a jig is first placed in operation, it may take several hours or a day to develop a good bed of heavy minerals even though a considerable amount of shot is used as a base. Meanwhile, an excess of sand will settle into the hutch. After a good bed has been built up, the best jigging conditions obtain. As operation continues, tramp iron and copper collect on the jig screen and fine sulphide particles become locked in the interstices until eventually jigging action is considerably hampered or prevented altogether. Even over a period of eight hours the bed becomes tight and impervious in spots.

For these reasons it is customary to stir or rabble the bed once every eight to twenty-four hours and to clean the screen once every two to four weeks. If an ore is deficient in sulphide minerals, it may be necessary to add some clean minerals to the bed, when operation is begun again, to aid in the development of a good bed. If a very large proportion of the ore is coarse

Example of Economic Jig Recovery

Assume:

V_b	= price received for gold bullion (deductions made for mint charges and express)	=	\$34.80/oz.
V_c	= price received for gold in concentrates (deductions made for treatment, penalties, freight)	=	\$30.80/oz.
h	= mill heads assay	=	0.15 oz./ton
T	= tonnage each day	=	100 tons/day
L	= labor cost of jig	=	\$4.50/day
C	= capital cost of jig (\$3,000, interest and sinking fund, for four years at 4% and 2%)	=	\$2.33/day
M	= operating cost: maintenance \$0.02; mercury 0.40; power 0.36		
	0.78	=	\$0.78/day
	total cost = \$0.076/ton	or	\$7.61/day
t_1	= tailings assay with flotation alone	=	0.015 oz./ton
t_2	= tailings assay with jig in circuit	=	0.014 oz./ton

Find:

R_e = minimum economic jig recovery

Saving each day = $R \cdot h \cdot T\,(V_b - V_c) + (t_1 - t_2)\,T \cdot V_c$

Cost each day = $L + C + M$

R is a minimum when saving = cost:

$$R_e \cdot h \cdot T\,(V_b - V_c) + (t_1 - t_2) \cdot T \cdot V_c = L + C + M$$

$$R_e = \frac{(L + C + M) - (t_1 - t_2) \cdot T \cdot V_c}{h\,T\,(V_b - V_c)}$$

For the above assumptions (100-ton mill treating \$5.25 ore)

$$R_e = \frac{4.50 + 2.33 + 0.78 - (.001 \cdot 100 \cdot 30.80)}{0.15 \cdot 100 \cdot (34.80 - 30.80)}$$

$$R_e = \frac{4.53}{60.00} = 0.0755 \text{ or } 7.55\%$$

Any jig recovery greater than 7.55% will increase profits for this example.

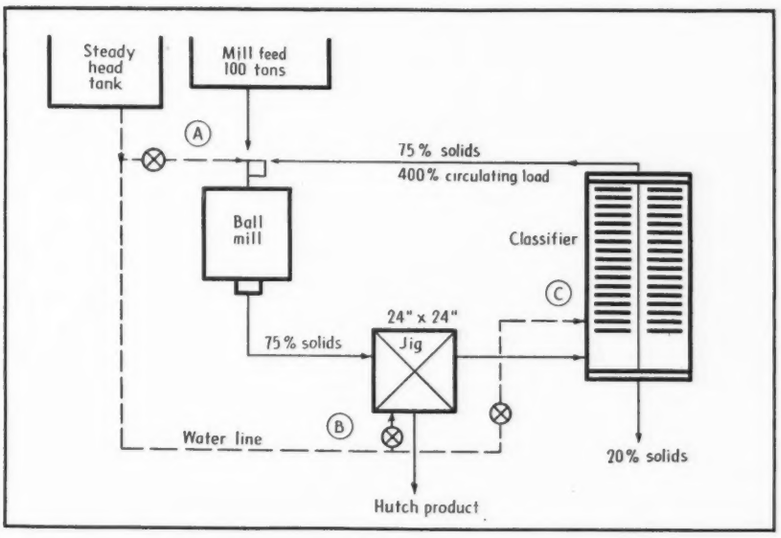


Fig. 9. . . . A flowsheet serving to illustrate the accompanying calculation of the distribution of water in a mill circuit. Points A, B and C are referred to in the text

Example of Calculation of Water Distribution in Mill Circuit

Assume:

Feed = 100 tons/day
Circulating load = 400%
Classifier overflow dilution desired = 20% solids
Classifier return = 75% solids

Find:

Amount of water to put into circuit at points A, B, and C. (See Fig. 9.)

Calculations:

$$\text{Water removed at classifier overflow} = \frac{100}{0.20} - 100 = 400 \text{ tons/day}$$

$$\text{Ore passing over jig} = 100 + 400 = 500 \text{ tons/day}$$

$$\text{Water approaching jig} = \frac{500}{0.75} - 500 = 166 \text{ tons/day}$$

$$\text{Water in circulating load} = \frac{400}{0.75} - 400 = 133 \text{ tons/day}$$

Water to be added at A = 166 − 133 = 33 tons/day
If 15 gal./sq.ft./min. are needed for jig hutch (hydraulic jig), then, for a 24-in. jig

$$4 \times 15 = 60 \text{ g.p.m.} = \frac{60 \times 1440 \times 8.33}{2{,}000} = 360 \text{ tons/day}$$

Amount of water to be admitted at B = 360 tons/day
Amount of water to be admitted at C = 400 − 33 − 360 = 7 tons/day

Summary:

Water at A	33 tons/day	8,000 gal./day	5.6 g.p.m.
Water at B	360 tons/day	86,400 gal./day	60.0 g.p.m.
Water at C	7 tons/day	1,600 gal./day	1.1 g.p.m.
Total Water	400 tons/day	96,000 gal./day	66.7 g.p.m.

sulphides, it may be necessary to remove part of the bed at intervals to prevent the accumulation of too uniform or too deep a bed. A reasonable thickness (1 to 2 in.) of pulp should remain in teeter on top of the bed.

Amalgamation—This process is intimately related to jigging because it is usually used to recover the gold from jig concentrates. Unfortunately, it involves much hand labor. A continuous amalgamator makes the process considerably cheaper when enough material is being treated to make its use economically sound.

Grinding concentrates in batches is the usual practice. Small gold particles are released and consequently the recovery is greater. However, gold particles smaller than 700 mesh are amalgamated with difficulty, probably because they remain suspended in the pulp. The best grinding practice must be determined by trial, so as to release gold but not comminute the released particles.

If the gold is coated with rust, grinding a sandy concentrate usually scratches the gold particles so that they will amalgamate. It is sometimes expedient to mix jig and flotation concentrates for amalgamation. Grinding a sandy concentrate with mercury in an alkaline lime or sodium hydroxide solution will usually give good recovery in spite of the popular belief that flotation concentrate will not amalgamate.

Capacity—The capacity of a jig is determined chiefly by the width of the jig bed and to a less extent by the length. Most jigs are built as square units but are often used in tandem, the advantage being that the second unit can operate with different stroke, water and bed conditions, and so recover finer material. When two units are used in this manner, the capacity is largely governed by the size of the first unit. Because of the difficulty of evaluating the effect of the width and the effect of the length, the capacity of the jigs is generally expressed in terms of tons per square foot of jig-bed area for a certain period.

Placer sands are treated in open circuit, and both Bendelari and Pan-American mechanical diaphragm jigs can successfully treat as much as 60 tons per square foot per 24 hours.

The capacity of a jig in a closed circuit with some crushing or grinding machine is about the same, rating the capacity on the amount of new feed supplied to the circuit. The Pan-American pulsator jig is listed as being able to treat 40 to 50, the Titan jig 60 to 80, and the Denver jig 40 to 50 tons per square foot per day. If it is assumed that these jigs usually carry 500 per cent circulating load, they are actually handling material at the rate of 250 tons per square foot per day or more.

The indicated capacity of the mines studied in California varies from 12 to 36 tons of new feed in those mines which may be considered examples of good practice; the average of these mines is 26 tons, and of all mines is 36 tons per square foot per day. Almost all of these mines operated the jigs in closed circuit with a fairly large circulating load.

Mechanical Conditions—The average California practice for stroke and speed is shown in Table IV. The screen and shot sizes depend on the size of the concentrate desired. The

Table III—Hutch Water

Type	G.p.m. Per Sq. Ft. Bed Area
Conventional mechanical diaphragm jig.	5–10
Denver type rotary valve jig	2–5
Hydraulic diaphragm jig	12–25

Table IV—Stroke and Speed

Feed Size	3 Mesh to 20 Mesh	20 Mesh to 200 Mesh
Mechanical Jigs		
Stroke, diaphragm	⅜–1 in.	1/16–⅜ in.
Speed, strokes per minute	120–160	160–350
Hydraulic Jigs		
Stroke, valve	½–1 in.	1/16–½ in.
Speed, strokes per minute	250–400	400–600

size of the voids determines the effectiveness of sifting. A coarse bed (e.g. ¼-in. shot) recovers a coarse concentrate and has a larger capacity but will not exclude sand efficiently. A fine bed (e.g. 3/32-in. shot) recovers small grains effectively and produces a cleaner concentrate. The choice involves a knowledge of the size distribution of the ore minerals.

Costs—The cost of single-cell mechanical jigs varies from $300 for an 8x12-in. unit to $645 for a 42x42-in. unit. The hydraulic type costs somewhat less, $250 for a 12x12-in. unit, $350 for a 24x24-in. unit. The cost of motor, switches, shot, valves, pipe, and freight, and the probable need for installation of amalgamation equipment, will usually bring the total cost to over $2,000 for installing a jig in a 100-ton mill. More elaborate installations such as jig and shaking table, or jig, unit cell and shaking table, will cost from $2,000 to $3,000. Thirty dollars per ton of installed daily capacity should be a safe estimate for jig equipment cost at all but small mines.

Labor is the chief cost in jig operation, unless the hutch product is in a continuous closed circuit with some other process. The concentrate usually is amalgamated in batches every day or every two days. This may require the employment of another man in the mill, or will require at least one-half shift each day from the time of one of the operators. The operation of the jig itself requires very little time, probably no more than ten minutes each shift. If some continuous automatic process of recovering the values in the concentrate is used, jigging costs are greatly reduced.

Available Types—If testing shows that jigs will return a profit, and mill conditions are favorable for jig installation, the remaining problem is to select a jig suited to the ore and the mill. Table I showing the distribution of the various makes found in California is printed in Part I, page 42, of the *E.&M.J.* for April. There are two important types, the mechanical and hydraulic. The larger mechanical jigs are dependable and require only a moderate amount of water. The smaller, high-speed mechanical jigs require less water and yield a high grade concentrate, but require careful adjustment to secure optimum operating results. The hydraulic type requires a large amount of water at a steady head, but can treat a larger volume of ore successfully when operated at a high speed. Usually mill conditions will indicate which type would be preferable.

Acknowledgments—D. N. Vedensky and P. Malozemoff, of the Pan-American Engineering Corporation, provided ideas and criticisms which have been used freely. Other manufacturers and operators offered information embodied in the text. The laboratory work was performed under the supervision of Professor O. C. Shepard, of Stanford University. His helpful suggestions and continued interest were invaluable.

Chromate Salts From Domestic Ores

An objective, as yet unattained, of some recent research work under way in the Pacific Northwest

THE United States Bureau of Mines is cooperating with the State College of Washington in the State Metallurgical Research Laboratory to make studies and investigations looking to the establishment of new metallurgical industries in the Northwestern States and thus provide a useful outlet for the power generated at Bonneville and Grand Coulee. An account of this work is given in Bulletin V, by H. A. Doerner and others, recently issued by the Bureau and the State College jointly. The tentative results are presented here in condensed form.

Utilization of domestic chromite ores is now of considerable interest to the Bureau. There are deposits of possible commercial value in Montana, California, Oregon, Washington, and Alaska. Development of the California and Oregon deposits has been active in recent years.[1] Use of chromite for making chromates, dichromates, and other chemicals represents only about 10 per cent of the domestic and 25 per cent of world consumption.[1] Present production of chrome chemicals is derived from imported ores. Inasmuch as many ores are not considered suitable for making chromates, there has been doubt regarding the domestic ores for that purpose. This investigation was made to study methods by which chromates and dichromates can be produced from domestic ores and to estimate the economic possibilities of the methods studied. Chromates are produced by only a few companies and details of the methods are not revealed. This investigation was made possible by cooperation between Washington State Electrometallurgical Laboratories and the United States Chrome Mines, Inc.

Preliminary Investigations—A report of preliminary investigations of the roasting reactions used to produce chromates was published by the Bureau in 1930,[2] but the work was discontinued because other problems were more urgent. Now out of print, it is summarized in the new bulletin. The most unexpected and interesting results were those obtained with mixtures of chromite, lime, and magnesia. High conversion without the addition of alkali salts such as had not previously been reported was obtained.

The mechanics of calcining is the chief problem in the production of chromates. If a stoichiometric mixture of pulverized ore and soda ash is heated to reaction temperature, the soda ash and its reaction products fuse and the material behaves like wet snow. If rabbled, it packs into a mass having slight porosity. The reaction ceases for lack of oxygen. Large excess of lime will give enough porosity so that frequent rabbling will permit adequate absorption of oxygen.

Small-scale tests do not furnish enough information for judging the feasibility of rabbling a specified charge in a modern hearth furnace. No direct information on current practice was discovered. The patent literature indicates that many efforts have been made to overcome the difficulties experienced when the usual mixtures of ore, soda ash, and lime are rabbled.

As might be expected, the ore-lime-magnesia mixture is much less fusible. The calcine produced usually was bright yellow, in marked contrast to the green color with lime or the brown with only magnesia. The color and the marked improvement in conversion indicate the formation of a double salt.

The extraction and recovery of a chromate salt from the lime-magnesia calcine present difficulties. Calcium chromate is only slightly soluble in water, and the strongest solutions obtained by a water leach contained only 2 per cent CrO_3. Dissolution was improved by saturating the pulp with CO_2 to convert the lime to a carbonate. This fact and also references in the

[1] Ridgway, Robert H.: "Chromite," U. S. Bureau of Mines Minerals Yearbook 1938, p. 541.

[2] Doerner, H. A.: "Roasting of Chromite Ores to Produce Chromates." Bureau of Mines R. I. 2999, 1930, 29 pp.

literature indicated that the following reaction could be obtained by using CO_2 under high pressure:

$$CaMg(CrO_4)_2+Na_2CO_3+CO_2=CaCO_3+MgCO_3+Na_2Cr_2O_7.$$

The investigation discussed in the new bulletin consisted of a series of tests on samples of concentrates produced from mixtures of Washington and California ores respectively. Calcining was done successively without alkali salts, with soda ash and lime or dolomite, and without lime. The comparative results are presented; likewise a comparison of the characteristics of the various types of furnaces and refractories used for lining. Leaching operations and purification of the chromate solutions are next described; likewise the subsequent conversion to dichromate by treatment with sulphuric acid, followed by a description of the steps of evaporation and crystallization.

A flowsheet is presented showing the sequence of the various steps involved in producing sodium chromate or sodium dichromate from chromite ore. It was designed for efficient, continuous, and nearly automatic operation requiring minimum labor and attention. Such a plant, it is said, could hardly operate on less than 20 tons of concentrate per day. In preparing this, the estimates of various manufacturers have been used freely and the bulletin gives the equipment suggested by the latter for the various operations, mentioning firm and trade names at times by way of specifying the general type of equipment that is most suitable.

Bins of carload capacity each are prescribed for the raw materials. Coarse-crushing equipment is not required. Details of the various steps of the flowsheet and of the equipment required follow:

Furnace—This may be an oil- or gas-fired reverberatory with a single 2,000-sq.ft. hearth having rabbles mounted on water-cooled arms. The rabbles must be cast from a heat-resistant alloy and able to withstand a temperature of 1,000 deg. C. A manufacturer recommends a 70-spindle, duplex Edwards-type roaster with 60 spindles to roast and 10 spindles to cool the calcine. Air for burners is to be preheated in the latter zone. Oil-fired burners will use about 500 lb. of oil per hour and 12,000 lb. of air per hour.

Waste-heat Boiler—Heat available in the combustion products as they leave the roaster will just be sufficient to generate the steam required for the evaporator. Calculations indicate that the boiler must generate 4,320 lb. of steam per hour at 20 lb. gage.

Wet-grinding Unit (for Calcine)—There will be about 4,160 lb. of calcine per hour containing 1,720 lb. of soluble chromate. No grinding tests have been made on this material, but a manufacturer has recommended for two-stage grinding one 5-ft. by 22-in. conical ball mill, 30-hp. motor; one 5-ft. by 36-in. conical ball mill, 40-hp. motor; two 3x8-ft. countercurrent classifiers. Probably smaller mills can be used. On the other hand, the feed to the first classifier contains 33.6 per cent solids and the overflow 20.7 per cent. The liquid medium is concentrated salt solution, and the bulky solids in the overflow will settle to a maximum of 40 per cent solids. Classification to give an overflow substantially free from plus 150-mesh particles will require a classifier with a relatively large, quiet settling compartment.

Washing Thickeners—The first thickener receives hourly 1,350 lb. of minus 150-mesh solids in a 42 deg. Bé. liquor containing 2,780 lb. Na_2CrO_4 dissolved in 5,170 lb. of water; 4,870 lb. of clear liquor (3,170 lb. H_2O+1,700 lb. salt); overflow and the thickened solids discharge with 3,100 lb. of liquor (2,000 lb. H_2O). The other thickeners receive 2,700 lb. of solids at the same dilution, but the concentration of salt in the liquor decreases; hence the settling rates increase with each step.

The hot calcine will raise the pulp temperature in the first ball mill to boiling. For maximum settling rates and to conserve the heat required for subsequent evaporation the mills, classifiers, and thickeners should be thermally insulated and the filter cake should be washed with hot water.

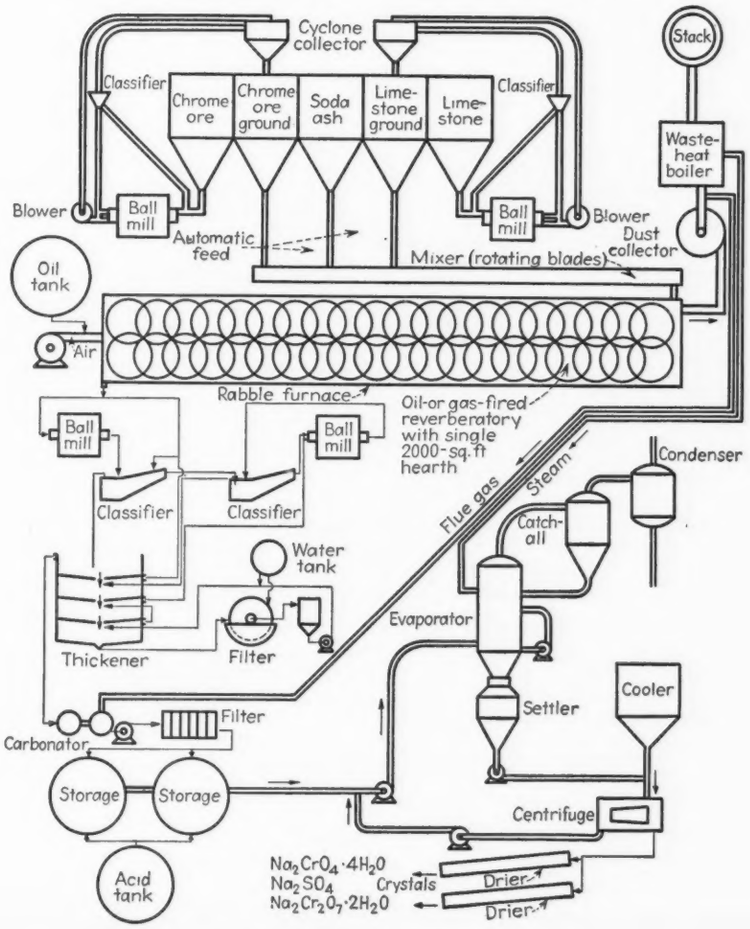
Filtration—Underflow from the last thickener, containing 42 per cent solids, is filtered and washed on a rotary vacuum filter. The light, bulky cake is permeable and retains about 31 per cent water. Maximum displacement requires that as large a proportion as possible of the make-up water be used to wash the cake. Cracks can be prevented by adequate wash water and by mechanical devices. The filter must treat hourly 2,700 lb. of solids in 3,700 lb. of liquor and wash with 3,000 to 4,840 lb. of make-up water.

Purification—Cake is discarded and strong liquor from the first thickener is run to purification tanks. About 400 gal. of liquor per hour must be aërated with enough flue gas to saturate it with CO_2. A manufacturer recommended use of two units in series, each having an 18-in. duplex impeller mounted on a 54x54-in. tank and driven by a reducer and a 5-hp. motor. Flue gas passes countercurrently through the mixers at 35 c.f.m. Smaller 12-in. units might suffice.

About 10 lb. per hour (dry weight) of hydrated alumina and silica are precipitated in the mixers. Precipitate and other insoluble must be filtered out.

(*Continued on page 57*)

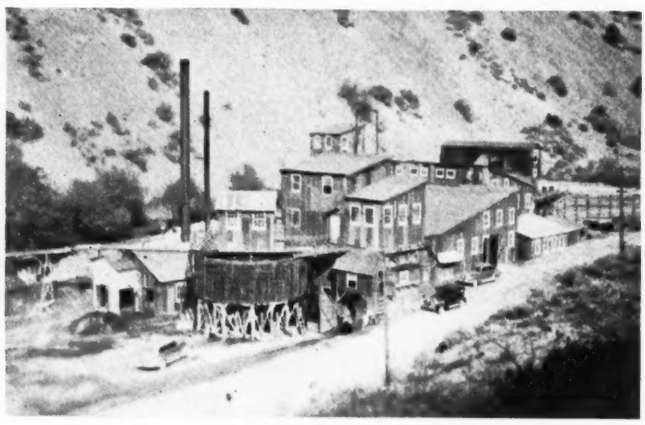
Flowsheet showing steps in producing sodium chromate



Re-treating Complex Tailings at Ophir, Utah

A 600-ton flotation plant handles both sands and slimes . . The latter present problems in excavating and milling

John B. Huttl
Assistant Editor



The 600-ton flotation plant of the International Smelting Company at Ophir, Utah

ONE of the most interesting tailings re-treatment operations in the West today is that of the International Smelting Company, at Ophir, Tooele County, Utah, where the tailings from gravity concentration at the old Ophir Hill are being worked. As known, the Ophir Hill Consolidated property was operated for many years by Senator William A. Clark and associates, and produced ore containing argentiferous galena, with pyrite, zinc, and copper, averaging 6 per cent lead, 1 to 3 per cent copper, and 6 oz. silver per ton. Milling was done in a 200-ton plant employing gravity concentration. From these activities 400,000 tons of tailings resulted, which were deposited in several dumps in the relatively narrow canyon just below the town of Ophir. The material consists of table tailings, both sands and slimes, assaying 2.2 per cent lead, about 50 per cent of which is oxidized; 2.1 per cent zinc; 3.07 per cent iron; 0.65 per cent copper; 58.6 per cent insoluble; 2.6 oz. of silver; and a trace of gold. The slimes in the ponds, because of their plastic nature (resembling modeling clay), offered a problem. After a campaign of sampling and metallurgical testing, the company began building a 600-ton flotation plant early in September, 1938. Active milling started Dec. 2, 1938.

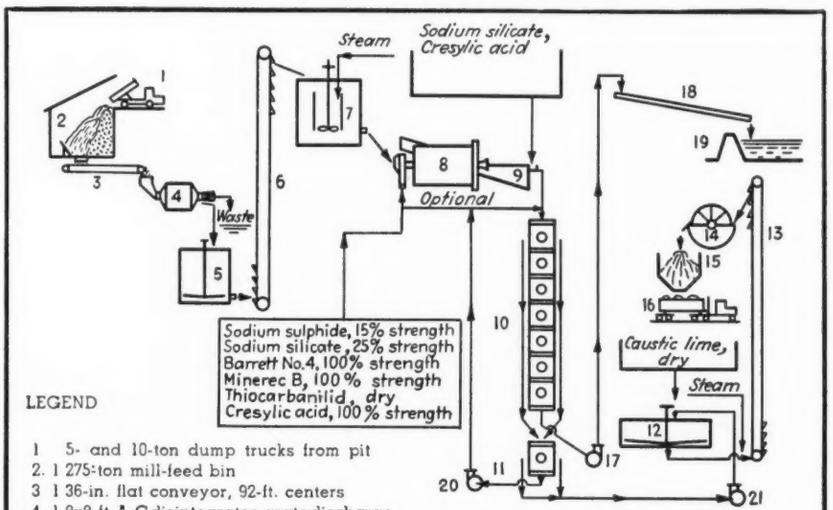
The mill building, a wooden structure covered with corrugated iron sheeting, is a little below the tailings dumps. The treatment given the reclaimed material is shown in the accompanying flowsheet. Though tried, removal of tailings by hydraulic methods was found impracticable because of the character of the slimes, and instead mining is done by a ¾-cu. yd. gasoline shovel loading into 10-ton end-dump trucks. This work is under contract. Hauling is done over a well-kept road having a grade favoring the loaded trucks.

From the 275-ton feed bin of the mill the material is moved onto a 36-in. horizontal conveyor by hand. Two men with hoes are employed in this work. The procedure is used (1) to provide a fairly uniform mill feed—that is, a feed composed of the proper mixture of sands and slimes—a matter which in conjunction with subsequent thorough disintegration influences metallurgical results materially; and (2) because the sticky slimes will not flow by gravity onto the feed belt.

Mill feed consists of 75 per cent sand and 25 per cent slimes. Moisture content of the sand at the bin varies from 3 to 6 per cent, and that of the slime from 30 to 35 per cent. Disintegration and preliminary mixing are accomplished in a large 8x8-ft. Allis-Chalmers ball mill equipped with a large quick-opening door to allow rapid dumping of excess rock loads, a grate discharge with a 30-in. feed opening, and a lining of 1-in. steel liners. Large rocks are fed into the mill periodically in conjunction with the tailings to help disintegration. The unit handles about 750 tons of material per day, and contains no ball charge.

Subsequent treatment involves pulping, grinding, flotation, thickening, and

Flowsheet of International Smelting Company's 600-ton flotation plant for treating old Ophir Hill table tailings



LEGEND

1 5- and 10-ton dump trucks from pit
2. 1 275-ton mill-feed bin
3 1 36-in. flat conveyor, 92-ft. centers
4. 1 8x8-ft. A-C disintegrator, grate discharge
5 2 15x15-ft. Goldfield sweep agitators
6 1 14-in. bucket elevator, 52-ft. centers
7 2 20x15-ft. Devereaux downcast agitators
8. 2 6x8½-ft. Marcy ball mills
9. 2 6x20-ft. Model D Dorr classifiers
10 2 to 7 56-in. Fagergren rougher flotation machines
11 2 to 1 56-in. SS Fagergren cleaners
12 1 10x30-ft Dorr thickener
13. 1 12-in. bucket elevator, 30-ft. centers
14. 1 8x8-ft Oliver filter
15. 1 100-ton concentrate bin
16 20- and 30-ton semi-trailer dump trucks
17 2 4-in Wilfley pumps, tailings
18. 1 Tailings launder ¼ in./ft., 12,000 ft.
19. Tailings pond
20. 3 3-in. Wilfley pumps, middlings
21 2 2-in. Wilfley pumps, concentrate

filtering. Preliminary test work showed that proper density of the pulp and contact time were prerequisites to high recoveries. Briefly, the problem was to provide a ball-mill feed as dense as possible, and a contact time in the mill of not less than 8 min. The first requirement was accomplished by the method of pulping explained in the flowsheet, and the second was reached by utilizing ball mills 8½ ft. long, heating the pulp to 85 deg. F., and adding appropriate reagents. Heating of the pulp alone is responsible for increasing the contact time from 1 to 4 min. The disintegrator product passing the openings of the circular screen or grate covering the discharge end of the unit flows to two 15x15-ft. Goldfield sweep agitators, whence it is subsequently elevated by a bucket elevator and discharged into two 20x15-ft. Devereux downcast agitators fitted with steam pipes. Steam for heating the pulp is obtained from two coal-fired boilers. The agitator product, which constitutes the ball-mill feed, contains the following screen sizes (average): Plus 35 mesh, 32 per cent, and minus 200 mesh, 42 per cent.

Two parallel circuits are available in the mill. Grinding is done in two 6x8⅛-ft. Marcy ball mills operating in closed circuit with two 6x20-ft. Dorr Model D classifiers. The mills originally were standard No. 64½ units, but were fitted with 4-ft. center rings to give the desired length. Overflow from the classifiers (22 per cent solids and averaging 1.5 per cent plus 65 mesh and 69 per cent minus 200 mesh) flows by gravity to two sets of seven-cell, 56-in. Fagergren rougher machines, each section having one 56-in. S. S. Fagergren cleaner unit. Tailings from the rougher machines are pumped by a 4-in. Wilfley sand pump to a wooden flume leading to the waste dump some 2½ miles distant. Finished concentrates are pumped to a 30x10-ft. Dorr thickener, and the cleaner tailings return to the heads of the rougher flotation units or to the ball mills. Wilfley sand pumps, 3 in. and 2 in. respectively, are employed in this work. The thickener underflow, after steam treatment, is elevated to an 8x8-ft. Oliver filter, which discharges the cake into a 100-ton concentrate bin. From here the concentrates are withdrawn into 20-ton semi-trailer dump trucks and shipped to the Tooele smelter, about 26 miles away.

Reagents are added at the ball-mill intake. Consumption per ton of ore treated is as follows: Sodium silicate, 1.25 to 5 lb.; sodium sulphide, 3.5 to 7 lb.; Barrett No. 4, 0.25 lb.; Minerec B, 0.06 lb.; thiocarbanalid, 0.15 lb.; and cresylic acid, 0.25 to 0.4 lb. To the classifier overflow 2 lb. of sodium silicate and 0.20 lb. cresylic acid are added. The thickener contents receive about 0.33 lb. caustic lime to increase the settling rate. Finished concentrates, of which from 60 to 90 tons are produced per day, assay 20 per cent lead; 30 oz. silver; 15 per cent zinc; 6 per cent copper; and 10.5 per cent insoluble. The tailings sent to waste contain the following values in per cent: Lead, 0.4; zinc, 0.6; copper, 0.012; iron, 2.2; insoluble, 63; and silver, 0.6 oz.

In conclusion I wish to express my thanks to Rip V. Thompson, superintendent in charge of operations at Ophir, for the data given here and for the courtesies shown me during my recent visit to the plant.

Split-Ring Connectors at Broken Hill

Device has been found advantageous at this Australian mine in building chute pony sets and gangway sets

G. R. Fisher
Mine Office
Zinc Corporation, Ltd.,
Broken Hill, New South Wales

Timber drill fitted with grooving tool at work

ADVANTAGES of the use of the split-ring timber connector in underground work were brought to the attention of the mine staff of the Zinc Corporation, at Broken Hill, N.S.W., in 1938, by J. E. Cummins, of the Council of Scientific and Industrial Research. The practice subsequently developed may be of interest to other operators engaged in similar work.

The connector was first made use of in building pony sets for chutes to feed 65-cu.ft. Granby-type cars. This eliminated the cutting of spills and mortises without in any way impairing the strength of the set. Connectors proved so successful, structurally and economically, that it was decided to use them in gangway sets. This also gave excellent results.

In construction, the connector is a mild-steel split ring, double galvanized, and 4 in. in diameter, 1½ in. high, and 3/16 in. thick, as shown in Fig. 1. It is inserted in grooves, 4 in. diameter by 13/16 in. deep, cut in the adjoining timbers by a grooving tool, which is made to fit into the chuck of the standard compressed-air timber drills used in the mine. The split makes the ring more flexible for fitting into the groove. The construction of the grooving tool is shown in Fig. 2.

The procedure for cutting the grooves is as follows:

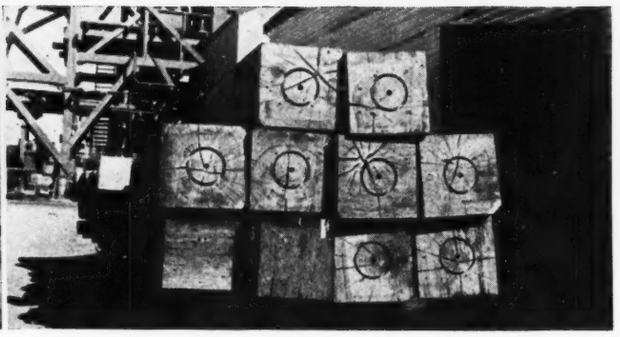
1. Lay out the timber for marking and boring.
2. Mark off the center of the groove.
3. Bore a pilot hole 7/16 in. diameter by 2 in. deep in the center position to carry the shaft of the grooving tool.
4. Cut the groove.

Using two air drills, one fitted with a 7/16-in. diameter auger and the other with a grooving tool, and taking into consideration the time to lay out and mark off the timber, one man can cut twenty grooves in the time it takes to cut one spill or mortise.

Split-ring connectors, double galvanized, are delivered at the mine at 8d. each. The grooving tools are made at the mine at a cost of £2 5s. each.

The reduction in cost of timber construction is estimated in the accompanying tabulation on page 54.

A split-ring connector and some of the grooves in mine timber that is ready for framing



Timber ready for framing, after the ends have been grooved for the split-ring connector

The small saving due to speed of erection is offset by the cost of cutting the grooves.

No difficulties have been encountered in fitting the timber underground. Repair costs to the sets, it is considered, will amount to the same as before, as the timber member would have to be cut in both cases.

Hardwood Pony Sets

	Previous System		With Rings	
	s.	d.	s.	d.
8 spills and 8 mortises at 1s. 3d.	20	0	..	..
8 split rings at 8d. each	..	..	5	4
16 grooves	..	..	1	3
Total	20	0	6	7
Total saving per set	..	..	13	5

Gangway Sets

	Saving Over Previous System	Cost With Rings
10x2-in. spreaders 1/7 ft. 4 in., 1/5 ft. 10 in.	21.9 super ft.	.....
10x10-in. legs — 2 (8 ft. 8 in. long instead of 9 ft. 0 in.)	5.6 super ft.	.....
10x4-in. backing pieces — 2 (8 ft. 8 in. long instead of 9 ft. 0 in.)	2.2 super ft.	.....
Saving in timber at 30s. 6d. per 100 super feet	9s. 1d	.....
4 split rings at 8d. each	.....	2s. 8d.
Total saving per set	.....	6s. 5d.

Fig. 1 . . . The split-ring timber connector, as used by Zinc Corporation's mining department

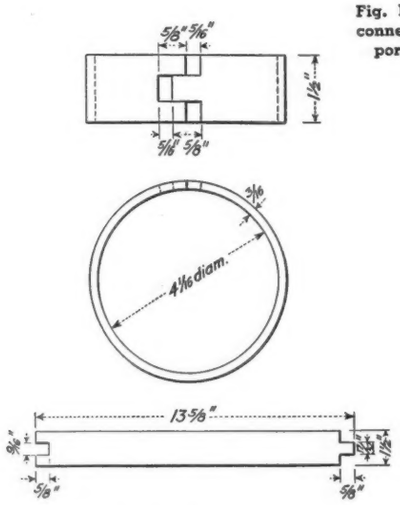
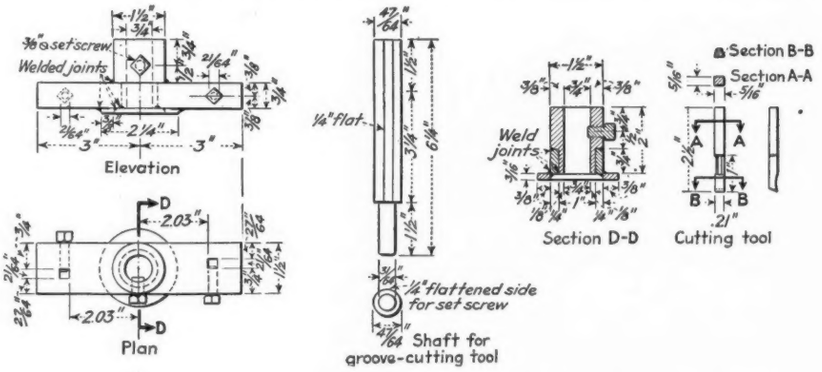


Fig. 2 . . . Details of timber grooving tool and of the cutting tool itself



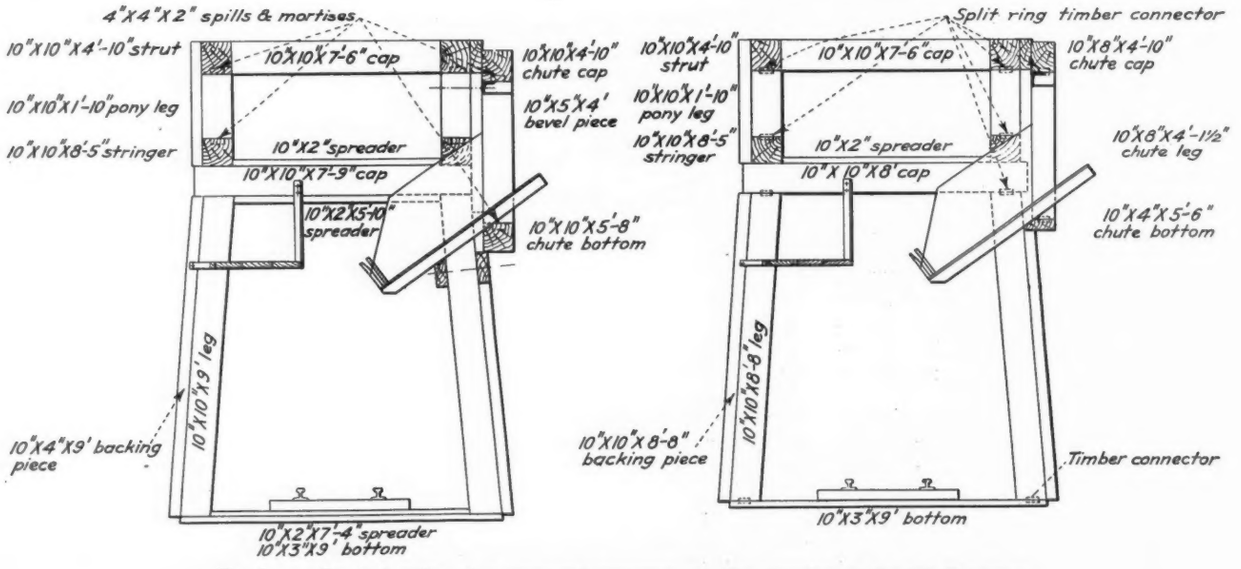


Fig. 3 . . . Front elevation of a pony and gangway set, The drawing at the left illustrates the use of "spills" and mortises; that at the right shows the split-ring timber connectors

Reconnaissance and Mapping Speeded by Tables

Special compilation proves to be useful in work with Brunton transit in the field

W. B. Phillips
Engineer, Kansas City Testing Laboratory, Kansas City, Mo.

IN RECONNAISSANCE SURVEYS, cases frequently arise where the time and expense involved in making a complete survey, including leveling, are not justified, but where it is nevertheless desirable, if not necessary, to have considerable fairly accurate information as to lines and levels. To obtain this information at least expense, I have prepared and used the accompanying tables for preliminary surveys of many kinds, including pipe-line, location of old boundaries, mining claims, and running the lines and ordinates necessary for laying out and recording core-drilling operation. The tables greatly simplify the work and eliminate hand leveling. Two men, using a compass, 100-ft. tape and clinometer, or a 100-ft. tape and Brunton transit, can cover two to three miles of line in a day, depending on the amount of brush, timber, ravines, or other obstacles.

Table I—The method of procedure varies slightly with the terrain but essentially is as follows: The rear chainman carries the Brunton. The front chainman carries a pole with a cross bar, marker, or target set at the height of the rear chainman's eye, and this is the point on which he sights to obtain the angle of the slope. The angle read on a Brunton is of course the horizontal angle. The tape is stretched and the front chainman signaled into the desired line as indicated by the Brunton. The rear chainman then reads the slope angle in even degrees, and records both course and angle in his field book, followed by a check mark to indicate that the full length of the tape was used. Short courses, either at the top or bottom of a slope, are handled in the same manner except that the check mark is replaced by the exact length of the course in feet. Measurements are taken along the ground where it is possible to do so, but in brush or boulder fields they are taken at eye level and carried to the ground with small plumb bobs which are easily carried in the pocket. Downhill courses are minus,

Table I—Functions of α Right Triangle
Hypotenuse = 100

Hor. Angle, °	Hypotenuse		Vertical Leg		Vert. Angle, °	Hor. Angle, °	Base		Vertical Leg		Vert. Angle, °
	Units	Ft. & In.	Units	Ft. & In.			Units	Ft. & In.	Units	Ft. & In.	
1	99.9848	99–11 13/16	1.7452	1– 8 15/16	89	46	69.4658	69– 5 9/16	71.9340	71–11 3/16	44
2	99.9391	99–11 1/4	3.4899	3– 5 7/8	88	47	68.1998	68– 2 3/8	73.1354	73– 1 5/8	43
3	99.8629	99–10 3/8	5.2336	5– 2 13/16	87	48	66.9131	66–10 15/16	74.3145	74– 3 3/4	42
4	99.7564	99– 9 1/16	6.9756	6–11 11/16	86	49	65.6059	65– 7 1/4	75.4710	75– 5 5/8	41
5	99.6195	99– 7 7/16	8.7156	8– 8 9/16	85	50	64.2788	64– 3 3/8	76.6044	76– 7 1/4	40
6	99.4522	99– 5 7/16	10.4528	10– 5 7/16	84	51	62.9320	62–11 3/16	77.7146	77– 8 9/16	39
7	99.2546	99– 3 1/16	12.1869	12– 2 1/4	83	52	61.5661	61– 6 13/16	78.8011	78– 9 5/8	38
8	99.0268	99– 0 5/16	13.9173	13–11	82	53	60.1815	60– 2 3/16	79.8635	79–10 3/8	37
9	98.7688	98– 9 1/4	15.6434	15– 7 3/4	81	54	58.7785	58– 9 5/16	80.9017	80–10 15/16	36
10	98.4808	98– 5 3/4	17.3648	17– 4 3/8	80	55	57.3576	57– 4 5/16	81.9152	81–11	35
11	98.1627	98– 1 15/16	19.0809	19– 0 1/16	79	56	55.9193	55–11 1/16	82.9038	82–10 7/8	34
12	97.8148	97– 9 3/4	20.7912	20– 9 1/2	78	57	54.4639	54– 5 9/16	83.8671	83–10 3/8	33
13	97.4370	97– 5 1/4	22.4951	22– 5 15/16	77	58	52.9919	52–11 7/8	84.8048	84– 9 11/16	32
14	97.0296	97– 0 3/8	24.1922	24– 2 5/16	76	59	51.5038	51– 6 1/16	85.7167	85– 8 5/8	31
15	96.5926	96– 7 1/8	25.8819	25–10 9/16	75	60	50.0000	50– 0	86.6025	86– 7 1/4	30
16	96.1262	96– 1 1/2	27.5637	27– 6 3/4	74	61	48.4810	48– 5 3/4	87.4620	87– 5 9/16	29
17	95.6305	95– 7 9/16	29.2372	29– 2 7/8	73	62	46.9472	46–11 3/8	88.2948	88– 3 9/16	28
18	95.1056	95– 1 1/4	30.9017	30–10 13/16	72	63	45.3990	45– 4 13/16	89.1006	89– 1 3/16	27
19	94.5519	94– 6 5/8	32.5568	32– 6 11/16	71	64	43.8371	43–10 1/16	89.8794	89–10 9/16	26
20	93.9693	93–11 5/8	34.2020	34– 2 7/16	70	65	42.2618	42– 3 1/8	90.6308	90– 7 9/16	25
21	93.3580	93– 4 5/16	35.8368	35–10 1/16	69	66	40.6737	40– 8 1/16	91.3545	91– 4 1/4	24
22	92.7184	92– 8 5/8	37.4607	37– 5 1/2	68	67	39.0731	39– 0 7/8	92.0505	92– 0 5/8	23
23	92.0505	92– 0 5/8	39.0731	39– 0 7/8	67	68	37.4607	37– 5 1/2	92.7184	92– 8 5/8	22
24	91.3545	91– 4 1/4	40.6737	40– 8 1/16	66	69	35.8368	35–10 1/16	93.3580	93– 4 5/16	21
25	90.6308	90– 7 9/16	42.2618	42– 3 1/8	65	70	34.2020	34– 2 7/16	93.9693	93–11 5/8	20
26	89.8794	89–10 9/16	43.8371	43–10 1/16	64	71	32.5568	32– 6 11/16	94.5519	94– 6 5/8	19
27	89.1006	89– 1 3/16	45.3990	45– 4 13/16	63	72	30.9017	30–10 13/16	95.1056	95– 1 1/4	18
28	88.2948	88– 3 9/16	46.9472	46–11 3/8	62	73	29.2372	29– 2 7/8	95.6305	95– 7 9/16	17
29	87.4620	87– 5 9/16	48.4810	48– 5 3/4	61	74	27.5637	27– 6 3/4	96.1262	96– 1 1/2	16
30	86.6025	86– 7 1/4	50.0000	50– 0	60	75	25.8819	25–10 9/16	96.5926	96– 7 1/8	15
31	85.7167	85– 8 5/8	51.5038	51– 6 1/16	59	76	24.1922	24– 2 5/16	97.0296	97– 0 3/8	14
32	84.8048	84– 9 11/16	52.9919	52–11 7/8	58	77	22.4951	22– 5 15/16	97.4370	97– 5 1/4	13
33	83.8671	83–10 3/8	54.4639	54– 5 9/16	57	78	20.7912	20– 9 1/2	97.8148	97– 9 3/4	12
34	82.9038	82–10 7/8	55.9193	55–11 1/16	56	79	19.0809	19– 0 15/16	98.1627	98– 1 15/16	11
35	81.9152	81–11	57.3576	57– 4 5/16	55	80	17.3648	17– 4 3/8	98.4808	98– 5 3/4	10
36	80.9017	80–10 15/16	58.7785	58– 9 5/16	54	81	15.6434	15– 7 3/4	98.7688	98– 9 1/4	9
37	79.8635	79–10 3/8	60.1815	60– 2 3/16	53	82	13.9173	13–11	99.0268	99– 0 5/16	8
38	78.8011	78– 9 5/8	61.5661	61– 6 13/16	52	83	12.1869	12– 2 1/4	99.2546	99– 3 1/16	7
39	77.7146	77– 8 9/16	62.9320	62–11 3/16	51	84	10.4528	10– 5 7/16	99.4522	99– 5 7/16	6
40	76.6044	76– 7 1/4	64.2788	64– 3 3/8	50	85	8.7156	8– 8 9/16	99.6195	99– 7 7/16	5
41	75.4710	75– 5 5/8	65.6059	65– 7 1/4	49	86	6.9756	6–11 11/16	99.7564	99– 9 1/16	4
42	74.3145	74– 3 3/4	66.9131	66–10 15/16	48	87	5.2336	5– 2 13/16	99.8629	99–10 3/8	3
43	73.1354	73– 1 5/8	68.1998	68– 2 3/8	47	88	3.4899	3– 5 7/8	99.9391	99–11 1/4	2
44	71.9340	71–11 3/16	69.4658	69– 5 9/16	46	89	1.7452	1– 8 15/16	99.9848	99–11 13/16	1
45	70.7107	70– 8 1/2	70.7107	70– 8 1/2	45						

up-hill courses plus. At the end of the day, Table I, headed "Functions of a Right Triangle, Hypotenuse = 100," is entered from the left-hand or horizontal angle column and the horizontal distance and rise for each course are read under "Base" and "Vertical Leg" respectively. Inches and fractions to the nearest sixteenth of an inch are given for convenience where inch measurements are wanted on individual courses in the field. The figures given in this table are percentages of the hypotenuse and are to be used as such when figuring short runs.

The accompanying example illustrates the method of using this table. The field notes were taken from a course beginning on the bank of a dry wash and following the outcrop of a vein up a steep slope to the sharp crest of a hill, and down the far side to a saddle. All readings were taken with a Brunton transit.

Table II—Where it is desired to lay out even units of horizontal distance on hilly ground, as for evenly spaced drill holes, base lines from which ordinates are to be run at 100 ft. or a multiple of 100 ft. apart, or in laying out mining claims, Table II is used.

Course	Slope	Surface Distance, Ft.	Horizontal Distance, Ft.		Rise or Fall, Ft.
N 30° E	18°	100	95.1056		30.9017
N 31° E	21°	100	93.3580		35.8368
N 33° E	26°	100	89.8794		43.8371
N 33° E	31°	100	85.7167		51.5038
N 34° E	35°	92x0.819152	75.3620	92x0.573576	52.7690
N 34° E	−4°	56x0.997564	55.8636	56x0.069756	−39.0634
			Total horizontal distance.....		495.2853

Rise from 1st station to point of shoulder = sum of first 5 lines or 214.8484 ft.
Elevation of last stake above starting point..... 175.7850 ft.
Total distance covered "surface measure" = 548 ft.

The same equipment is used as described in the foregoing, and, in addition, a copy of Table II is carried in the rear chainman's field book and so arranged as to be quickly accessible, and another 100 ft. tape is attached to the first.

When the first 100 ft. of tape is stretched, the vertical angle of the slope is read by the rear chainman, who then refers to Table II and finds the hypotenuse corresponding to this horizontal angle. The additional footage is added to the course from the second tape and the front stake set, laying off an even 100 ft. on the horizontal. This is continued until the end of the line is reached. In case an extra long course, such as the crossing of a stream requiring several tapes to reach from bank to bank, is met, a short course would be added to the long one to make it an exact multiple of the required spacing, or if a break in spacing is permissible, the odd course could be quickly figured from the table, as the hypotenuse and vertical leg, as shown, are percentages of the base. In this table the units column under the heading "Vertical Leg" is also the per cent of grade.

Table II—Functions of a Right Triangle
Base = 100

Hor. Angle, °	Hypotenuse Units	Hypotenuse Ft. & In.	Vertical Leg Units	Vertical Leg Ft. & In.	Vert. Angle, °	Hor. Angle, °	Hypotenuse Units	Hypotenuse Ft. & In.	Vertical Leg Units	Vertical Leg Ft. & In.	Vert. Angle, °
1	100.0152	100- 0 3/16	1.7455	1- 8 15/16	89	46	143.9556	143-11 7/16	103.5530	103- 6 5/8	44
2	100.0609	100- 0 3/4	3.4921	3- 5 7/8	88	47	146.6279	146- 7 9/16	107.2368	107- 2 13/16	43
3	100.1372	100- 1 5/8	5.2408	5- 2 7/8	87	48	149.4476	149- 5 3/8	111.0612	111- 0 3/4	42
4	100.2442	100- 2 15/16	6.9927	6-11 15/16	86	49	152.4253	152- 5 1/8	115.0368	115- 0 7/16	41
5	100.3820	100- 4 9/16	8.7489	8- 9	85	50	155.5724	155- 6 7/8	119.1753	119- 2 1/8	40
6	100.5508	100- 6 5/8	10.5104	10- 6 1/8	84	51	158.9016	158-10 13/16	123.4897	123- 5 7/8	39
7	100.7510	100- 9	12.2784	12- 3 5/16	83	52	162.4269	162- 5 1/8	127.9941	127-11 15/16	38
8	100.9827	100-11 13/16	14.0541	14- 0 5/8	82	53	166.1640	16 - 2	132.7045	132- 8 7/16	37
9	101.2465	101- 2 5/16	15.8384	15-10 1/16	81	54	170.1335	170- 1 5/8	137.6409	137- 7 11/16	36
10	101.5426	101- 6 1/2	17.6327	17- 7 9/16	80	55	174.3447	174- 4 1/8	142.8148	142- 9 3/4	35
11	101.8717	101-10 7/16	19.4380	19- 5 1/4	79	56	178.8292	178- 9 15/16	148.2561	148- 3 1/16	34
12	102.2340	102- 2 13/16	21.2556	21- 3 1/16	78	57	183.6078	183- 7 5/8	153.9865	153-11 13/16	33
13	102.6304	102- 7 9/16	23.0868	23- 1 1/16	77	58	188.7080	188- 8 1/2	160.0334	160- 0 3/8	32
14	103.0614	103- 0 3/4	24.9328	24-11 3/16	76	59	194.1604	194- 1 15/16	166.4279	166- 5 1/8	31
15	103.5276	103- 6 5/16	26.7949	26- 9 9/16	75	60	200.0000	200- 0	173.2051	173- 2 7/16	30
16	104.0299	104- 0 3/8	28.6745	28- 8 1/8	74	61	206.2665	206- 3 3/16	180.4047	180- 4 7/8	29
17	104.5692	104- 6 13/16	30.5731	30- 6 7/8	73	62	213.0054	213- 0 1/16	188.0726	188- 0 7/8	28
18	105.1462	104- 1 3/4	32.4920	32- 5 7/8	72	63	220.2689	220- 3 1/4	196.2610	196- 3 1/8	27
19	105.7621	105- 9 1/8	34.4328	34- 5 3/16	71	64	228.1172	228- 1 7/8	205.0304	205- 0 3/8	26
20	106.4178	106- 5	36.3970	36- 4 3/4	70	65	236.6225	236- 7 1/2	214.4528	214- 5 7/16	25
21	107.1145	107- 1 3/8	38.3864	38- 4 5/8	69	66	245.8593	245-10 5/16	224.6036	224- 7 1/4	24
22	107.8535	107-10 1/4	40.4026	40- 4 13/16	68	67	255.9305	255-11 3/16	235.5853	235- 7	23
23	108.6360	108- 7 5/8	42.4475	42- 5 5/8	67	68	266.9467	266-11 5/8	247.5087	247- 6 1/8	22
24	109.4636	109- 5 9/16	44.5228	44- 6 1/4	66	69	279.0428	279- 0 1/2	260.5089	260- 6 1/8	21
25	110.3378	110- 4 1/16	46.6308	46- 7 9/16	65	70	292.3805	292- 4 9/16	274.7478	274- 9	20
26	111.2602	111- 3 1/8	48.7732	48- 9 1/4	64	71	307.1553	307- 1 7/8	290.4210	290- 5 1/16	19
27	112.2326	112- 2 13/16	50.9525	50-11 7/16	63	72	323.6068	323- 7 1/4	307.7683	307- 9 1/4	18
28	113.2569	113- 3 1/16	53.1709	53- 2 1/16	62	73	342.0304	342- 0 3/8	327.0853	327- 1	17
29	114.3354	114- 4	55.4309	55- 5 3/16	61	74	362.7962	362- 9 9/16	348.7420	348- 8 7/8	16
30	115.4700	115- 5 5/8	57.7350	57- 8 13/16	60	75	386.3704	386- 4 7/16	373.2051	373- 2 7/16	15
31	116.6633	116- 7 15/16	60.0860	60- 1 1/16	59	76	413.3565	413- 4 1/4	401.0780	401- 0 15/16	14
32	117.9178	117-11	62.4870	62- 5 7/8	58	77	444.5410	444- 6 1/2	433.1474	433- 1 3/4	13
33	119.2363	119- 2 13/16	64.9407	64-11 5/16	57	78	480.9734	480-11 11/16	470.4630	470- 5 9/16	12
34	120.6218	120- 7 7/16	67.4508	67- 5 7/16	56	79	524.0843	524- 1	514.4554	514- 5 7/16	11
35	122.0775	122- 0 15/16	70.0208	70- 0 1/4	55	80	575.8770	575-10 1/2	567.1282	567- 1 9/16	10
36	123.6068	123- 7 1/4	72.6543	72- 7 7/8	54	81	639.2452	639- 2 15/16	631.3750	631- 4 1/2	9
37	125.2136	125- 2 9/16	75.3554	75- 4 1/4	53	82	718.5296	718- 6 3/8	711.5369	711- 6 7/16	8
38	126.9018	126-10 13/16	78.1285	78- 1 9/16	52	83	820.5512	820- 6 5/8	814.4350	814- 5 1/4	7
39	128.6759	128- 8 1/16	80.9784	80-11 5/8	51	84	956.6769	956- 8 1/8	951.4360	951- 5 1/4	6
40	130.5407	130- 6 1/2	83.9099	83-11 1/16	50	85	1147.372	1147- 4 1/2	1143.006	1143- 0 1/16	5
41	132.5013	132- 6	86.9287	86-11 1/8	49	86	1433.558	1433- 6 11/16	1430.066	1430- 0 13/16	4
42	134.5633	134- 6 3/4	90.0403	90- 0 1/2	48	87	1910.731	1910- 8 3/4	1908.112	1908- 1 5/16	3
43	136.7327	136- 8 13/16	93.2515	93- 3	47	88	2865.370	2865- 4 7/16	2863.624	2863- 7 1/2	2
44	139.0163	139- 0 5/16	96.5688	96- 6 13/16	46	89	5729.871	5729-10 7/16	5728.998	5728-11 15/16	1
45	141.4213	141- 5 1/16	100.0000	100- 0	45						

Chromate Salts from Domestic Ores

(*Continued from page* 51)

This precipitate is gelatinous, but filtration may be speeded by diatomite or other filter aid. An 18-in. plate-and-frame clarifying press with automatic removal of cake can be used with a 400-gal. diaphragm pump. Unless the press can be cleaned rapidly, storage will be required.

The cake can be returned to leaching without washing to recover the chromate. The filtrate is run to evaporator storage. These tanks should have 5,000 gal. capacity and be provided with agitators.

Conversion to Dichromate—If sodium chromate is required, the liquor is run directly from storage to evaporator. To make sodium dichromate, sulphuric acid is added to a batch in one of the tanks. The quantity can be calculated from the amount of sodium chromate in the tank, but the final addition should be determined or checked by pH measurement. After adding acid, the liquor must be mixed thoroughly before a pH sample is taken.

Evaporating — To produce hydrated sodium chromate, the evaporator must treat daily a 42-deg. Bé. solution of 41,000 lb. of Na_2CrO_4 in 76,000 lb. of water. It should operate at 140 deg. F. and 1.20 lb. of absolute pressure to produce a saturated solution from which chromate crystals are removed continuously.

To produce sodium dichromate, the daily feed will be 38,000 lb. $Na_2Cr_2O_7$ $(2H_2O)$ and 18,000 lb. Na_2SO_4 dissolved in 71,000 lb. of water plus 9,000 lb. of wash water. The evaporator may operate at 176 deg. F. and 2.79 lb. absolute pressure to produce a saturated dichromate solution with continuous removal of sodium sulphate crystals. Large batches of saturated dichromate liquor are transferred at intervals to a crystallizer in which the liquor is cooled from 176 deg. F. to 70 deg. F. (or lower if possible). About 70 per cent of the dichromate will crystallize. The liquor is separated from the crystals and returned to the evaporator.

Recommendations as to this and other equipment are set forth in the bulletin.

Filtration of Salt Crystals — These may be separated from the liquor by various filters, but a centrifuge gives the most rapid and complete separation. The usual batch-type of whizzer would be satisfactory, but a centrifuge with reliable mechanism for continuous discharge of crystals would save one man. The machine must treat daily a thick slurry containing either 60,000 lb. Na_2CrO_4 $(4H_2O)$ or 18,000 lb. Na_2SO_4 plus 38,000 lb. of $Na_2Cr_2O_7$ $(2H_2O)$. The sodium sulphate crystals must be washed thoroughly.

Drying—One drier could be used to dry the three products alternately; but to avoid contamination, a separate drier for each is preferable. The same unit might be used for the chromate and dichromate salts with a small one for the sulphate.

After centrifuging, the salts should not retain more than 1 per cent moisture. To remove this from 60,000 lb. of salt per day is a small problem. A rotary-drum hot-air drier would probably be most economical. Air can be heated by steam coils or by flue gas. Heat required will be a small fraction of the total used by calcining furnace and evaporators.

Cost Estimates—Prices for estimating were obtained for larger items of equipment. Cost of new equipment at factory is approximately $125,000. Minor items, such as small pumps and motors, may add $25,000. Freight charges will approximate $15,000, a building $30,000, and installation $20,000. The total is $215,000, which may be in error 15 per cent. At least $50,000 is needed for working capital, making a total investment of $265,000 to $300,000 for a 20-ton plant.

To produce sodium dichromate, the cost of 10 tons of 66 per cent H_2SO_4 at $22.50 must be added to the chromate costs. This gives a total of $1,483.20 per day. With the daily production of 38,000 lb. of $Na_2Cr_2O_7$ $(2H_2O)$ the cost is $0.0391 per pound.

Two-thirds of the total costs are for raw materials, the chromite ore alone accounting for nearly one-third. Therefore, the costs that cannot be estimated precisely are a relatively small per cent.

The value of $20 per ton for chromite is nominal, intended to represent the price a Pacific Coast producer might receive. Ore of lower grade must be evaluated at a lower figure to obtain the same cost per pound of product. If ore containing 45 per cent Cr_2O_3 is substituted and allowance made for saving in soda ash and acid, a price of $15 per ton will give the same cost per pound of product. But even at the same *unit* cost, the plant treating 45 per cent ore will make 10 per cent less profit than with 50 per cent ore. For the same daily profit on 45 per cent ore, it must be valued at less than $10 per ton. This point is likely to be disregarded by producers whose ores do not yield a high-grade product, and it explains the fact that a high chrome content is held essential for producing chromates.

Estimates of Operating Costs

(20-ton plant producing sodium chromate)

20 tons 50 per cent ore at $20	$400.00
30 tons limestone at $3.40	102.00
14 tons soda ash at $17.90	250.60
6.5 tons fuel oil at $9.40	61.10
Power, 8,500 kw.hr. at 0.5c	42.50
Labor	100.00
Supervision	30.00
Laboratory	30.00
Supplies	75.00
Interest and depreciation (20 per cent)	137.00
Overhead, taxes, etc.	30.00
Total	$1,258.20
Product, 60,000 lb. $Na_2CrO_4(4H_2O)$	
Cost per pound	0.021

▼ ▼ ▼

Prizes for Manganese Research

TO STIMULATE INTEREST and research in its electrolytic manganese, running 99.9 per cent Mn, and on alloys or compounds made with it, the Electro Manganese Corporation, of Knoxville, Tenn., has established three prizes of $150 each to be awarded for the three best papers produced by college undergraduate and graduate students before Sept. 21 next. This very pure manganese has been given the name "Electro manganese" by the company. The work done on it must be original in character and may be in the field of metallurgy, or metallography, or chemistry. It is stipulated that there shall not be more than two joint authors to a paper and that in case a paper so written is selected, the prize is to be divided equally between the two competitors. The conditions of the contest stipulate that:

1. Any winning author must have been enrolled as a registered undergraduate or graduate student during the time of the experimental work.

2. The subjects of all research papers should be submitted to the company as soon as possible in order that they can be compared and excessive duplication be avoided before the research work has progressed far. All aspirants will be supplied with Electro manganese without charge, so long as they employ reasonable quantities.

3. All papers must be submitted to the Electro Manganese Corporation, Research Department, 527 Rand Tower, Minneapolis, Minn., in duplicate, before midnight, Friday, Sept. 20, 1940, which is the deadline. One copy will be retained by the company and the remaining copy returned to the author.

4. The Electro Manganese Corporation retains the right to publish all or any parts of, or rewrite any portions of, all reports submitted; but the Corporation gives full credit upon such publication to the authors of the papers.

5. The authors will be encouraged to publish their own data or reports in any way they choose regardless of whether or not they are published by the company. It is suggested that the authors of winning papers shall incorporate a footnote at the start or end of the research paper, upon such publication, stating that: "The author (or authors) obtained an Electro Manganese Corporation research prize upon a paper based on this experimental work."

USEFUL OPERATING IDEAS

Clearing Clogged Screens

CLOGGING of wire-mesh screens may be caused by small particles of angular rock becoming wedged tightly, followed by rusting when the mill is stopped, so that the plugging of the hole is completed. It has been noted, writes Charles Labbe, of Johnnie, Nev., that when a screen is irregularly crowded or where the splash action is strongest, the blinding is slower, but the rusting tight is nevertheless complete after a shutdown, overnight being sufficient to permit this to happen.

Stainless-steel screens are expensive and, pending lower prices for them, the screens of plain steel have to be kept in service. After much experimenting, the best way found has been to lay the screen, when dry, on a piece of canvas upon a table and scrub it well on both sides with a wire brush having a conveniently bent handle, following this by brushing it on both sides with muriatic acid in which has been dissolved all the zinc possible (as for soldering). The acid brush can be made out of a piece of $\frac{3}{8}$-in. soft cable. If the screen is placed over a tub of water near a window, the light will show the worst places.

The acid is allowed to act for about 15 minutes, after which the screen is dipped in water to wash the acid off, together with the rusty mud. Again the screen is laid on the canvas and given another brushing. The result can be observed by holding the screen to the light. If it has been badly clogged, another acid treatment and brushing may be necessary. When the holes have been opened sufficiently, the screen should be washed in lye water, rinsed in clear water, and dried quickly. Some screens given up as hopeless answered the acid treatment. However, no time should be wasted in attempting to operate with worn screens having broken wires.

In handling the acid, the operator's clothes can be protected by an apron made out of a large inner tube, slit through at the rim side, with a few strings to make it complete for use when doing this.

Brass screens have the advantage of not rusting, so that they clog less readily. They are, however, softer and cannot be used with quicksilver, inasmuch as they amalgamate as well as a plate does and become brittle; in fact so brittle, when amalgamated, as to break between the fingers like a soda cracker. At that point some brought nearly $10 in gold per square foot after melting.

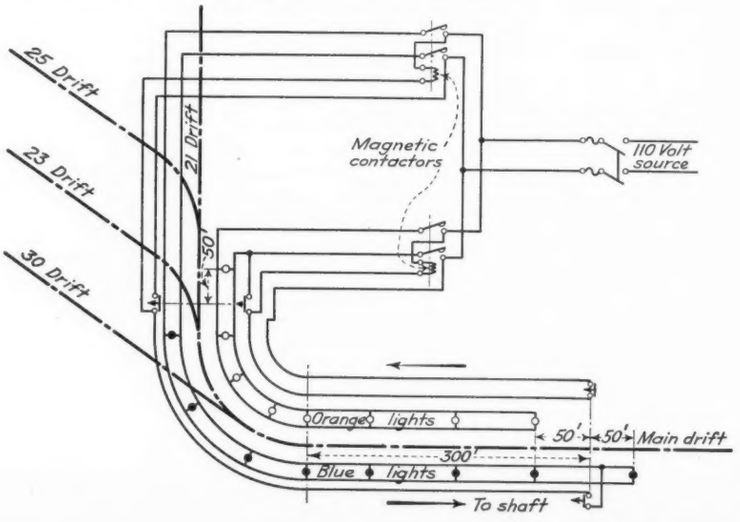
▼ ▼ ▼

Novel Track Signal System

AN OUTSTANDING FEATURE at the Emma mine of Consolidated Coppermines Corporation, Kimberly, Nev., is the successful and safe transportation of a large tonnage of broken ore (up to 9,000 tons per shift) to the surface with a plant of much smaller capacity. Broken material, timber, and supplies are handled through a single-track drift served by the Emma Nevada shaft. As loaded trains and empty trains must travel over the same track, a carefully coordinated service is essential to move the required tonnage quickly and with a minimum of interruption. An installation that has materially helped to bring this about on the single haulage level mentioned previously is a simple track-signal system, a wiring diagram of which is shown. Operation is as follows:

Trains moving between the dispatcher's station and the shaft loading pocket in either direction are spaced about 300 ft. by a series of orange and blue lights. The lights are in pairs, each spaced 75 ft. along the drift from the dispatcher's station to a point about 200 ft. north of No. 32 drift switch. Control switches fitted with pull cords are situated at each end of the block. The cords hang within easy reach of the motorman, he being the only person allowed to operate them. When a loaded train is directed to the shaft pocket the motorman pulls the cord on his right as he enters the block, thus turning all the lights blue around the curve. As he leaves the block, he again pulls the cord on his right, and with it turns out the blue lights. As soon as this has occurred another train can start into the block. Similarly, for returning empty trains the motorman pulls the cord on his right which turns on all orange lights, and turns them out when he leaves the block.

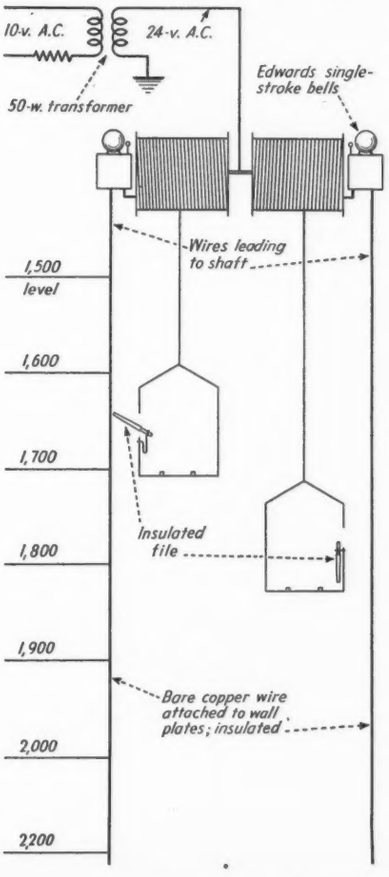
The signal system described has definitely relieved a dangerous condition. For example, a train leaving for the shaft pocket might be forced to stop at some point on the curve due to derailment or some other emergency, and without the light signal a train following might easily crash into the rear end of the stalled train. Also, in case of an error by the station man or train dispatcher a train might be routed each way and in a position to meet on the curve. A collision would be prevented as both motormen would stop when they saw both orange and blue lights burning. The signal system is simple, effective, and answers every purpose for the underground traffic problem. Mark A. Smith, mine superintendent for Consolidated Coppermines Corporation at the time of my visit, kindly supplied the material for the foregoing.



Emergency System For Shaft Signaling

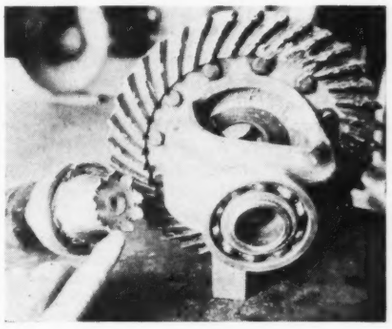
C. C. HEINRICH, general superintendent of Suyoc Consolidated Mining Company, Baguio, P. I., sends the accompanying sketch of an emergency signal system that, he says, is easy to install and is practically foolproof. Crouse-Hinds signal boxes are provided in all the stations, and the emergency signal is used when the cages are changing stations or when the shaft is being checked. When changing stations, the tender can give the signal from a position well inside the cage. When the shaft is being checked, the cage can be stopped at any point without the usual shouting or banging.

Two bare copper wires are strung on the dividers from the collar to the bottom level. These wires are connected to two Edwards single-stroke bells in the hoist room, which are grounded to the hoist. On each cage, an old round file, 10 in. long, is grounded to the side of the cage with a piece of flexible wire 2 ft. long and insulated on the hand end by clipping a piece of rubber hose 6 in. long over the file. A hole 1 ft. in diameter is cut in the protecting screen on the side of the cage near the copper wire. Current is furnished by cutting down the 110-volt current to 24 volts, the wires being grounded to the hoist.



When the cage tender wishes to give a signal, he taps the copper wire with the file, completing the circuit and ringing the signal bell. The copper wire actually used is 10 gage, but a larger wire is recommended. Although the shaft is very wet, this emergency system has given no trouble during the period of more than a year that it has been in service.

▼



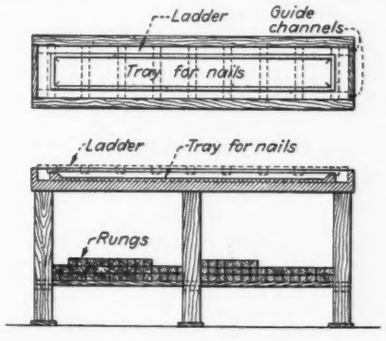
Lubrication Vital

TODAY the truck has become standard equipment in many mining operations, as well as the compressor, jackhammer, or other equipment. The care of these units is important, as the following, reported by Joseph C. Coyle, of Yuma, Ariz., bears witness: The speedometer on a Chevrolet pick-up truck owned by the Smuggler Gulch Mining Company, of Ruby, Ariz., showed 22,236 miles at a stop where a service station was supposed to lubricate the differential. Sixteen hundred miles later the truck ceased running, and the accompanying photograph shows how the ring gear and pinion looked. What is left of the pinion gears resembles a sunflower. The gears and differential case showed no signs of lubricant when taken down. Enough said!

▼

For Building Mine Ladders

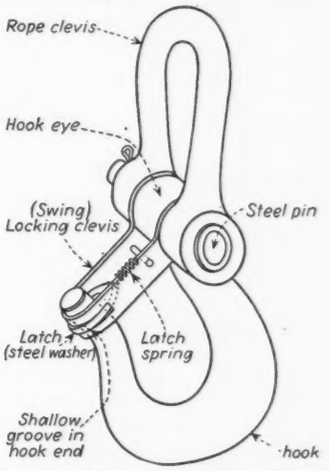
A SIMPLE JIG, here described, has proved valuable to the timber-framing shop at the Emma Nevada mine of Consolidated Coppermines Corporation, Kimberly, Nev., its use having speeded up the making of mine ladders. It consists of a long wooden table with a top containing two narrow guide grooves spaced according to the desired width of the ladder, and a tray covered with sheet iron to hold the nails needed for attaching the rungs. These are stored on a shelf available below the table top. The arrangement obviates the need of aligning the ladder posts, and with rungs and nails close at hand, there is no lost motion and no loss or waste of materials. The operator simply places the posts in the jig grooves and nails down the rungs.



▼

A Novel Safety Hook

FOR SAFE and continuous hoisting a hook should be fitted with a dependable lock to prevent accidental opening. The one developed at the Surcease mine, near Oroville, Calif., operated by Hoefling Brothers, of Sacramento, has been found satisfactory. The sketch shows it is made up of a sturdy steel hook, a U-shaped, steel locking clevis, simple lock mechanism, rope clevis, and steel pin. The lock mechanism, in turn, consists of a latch in the form of a steel washer fastened to the small spring on the cross pin of the locking clevis



and resting in the shallow groove near the end of the hook when in closed position.

Advantages claimed for the device include: (1) Simple design, which makes possible manufacture at any blacksmith shop; (2) the positive lock mechanism prevents any accidental opening; (3) the locking clevis reinforces the hook and eliminates a possible spreading of the hook; and (4) full throat clearance for the bail. The latch of the lock mechanism can be opened easily with a gloved hand simply by pulling it outwardly until the groove in the hook end has been cleared. Pressure or blows from one side only will not open the latch.

MONTHLY COMMENT • DAILY AND AVERAGE MONTHLY

Summary of the

MARKETS

SENTIMENT among traders in non-ferrous metals was mixed during the last month, being influenced by unsettling news from Europe. Germany's invasion of Denmark and Norway first inspired consumers to place a good volume of new business in copper, lead, and zinc, and prices strengthened. Later, however, buyers again hesitated, and business slackened. The statistics showed that production in most metals had overtaken consumption, and as April ended there was some talk of curtailing output of both copper and tin.

The *E. & M. J.* index of non-ferrous metal prices for April was 77.19, against 77.94 a month previous. The Federal Reserve Board's adjusted index of industrial activity, in which steel figures conspicuously, dropped from 109 in February to 103 in March. The recent high was 128 in December, 1939.

Domestic apparent consumption of copper is estimated at around 68,000 tons a month. Exports of domestic copper are down to about 7,000 tons a month. Production of crude in March (duty-free copper) was 85,466 tons.

Rumors were circulated late in the month that Russia intends to resell copper now tied up in United States ports because of the British blockade in the Pacific. This development unsettled the export market and made for confusion in the domestic trade. At least 15,000 tons were said to be involved, mostly foreign metal. Though large mine operators held to 11½c., Valley, custom smelters and small producers sold freely at 11¼c. as the month ended. Domestic sales for April totaled 41,641 tons, against 20,305 tons (revised) in March. The feature in the export division was the sale of more than 20,000 tons to Italy.

Except for an easier tendency in foreign lead, the domestic price would have advanced above 5.10c., New York, producers believe. Foreign zinc experienced no selling pressure, with the result that prices here were easily maintained.

UNITED STATES MARKET

1940	Electrolytic Copper		Straits Tin	Lead		Zinc
Apr.	Domestic (a) Refinery	Export (b) Refinery	New York	New York	St. Louis	St. Louis
1	10.900	11.100	44.750	5.05	4.90	5.75
2	10.900	11.075	45.750	5.00	4.85	5.75
3	10.900	11.050	45.625	5.00	4.85	5.75
4	10.900	11.050	45.500	5.00	4.85	5.75
5	10.975	11.000	45.500	5.00	4.85	5.75
6	11.025	11.100	45.750	5.00	4.85	5.75
8	11.025	11.125	46.000	5.00	4.85	5.75
9	11.150	11.375	47.250	5.00	4.85	5.75
10	11.275	11.425	47.500	5.10	4.95	5.75
11	11.275	11.450	47.500	5.10	4.95	5.75
12	11.275	11.425	47.250	5.10	4.95	5.75
13	11.275	11.425	46.500	5.10	4.95	5.75
15	11.275	11.350	46.500	5.10	4.95	5.75
16	11.275	11.375	47.250	5.10	4.95	5.75
17	11.275	11.325	47.500	5.10	4.95	5.75
18	11.150	11.350	47.500	5.10	4.95	5.75
19	11.100	11.350	47.375	5.10	4.95	5.75
20	11.100	11.325	47.125	5.10	4.95	5.75
22	11.025	11.325	47.125	5.10	4.95	5.75
23	11.025	11.275	47.325	5.10	4.95	5.75
24	11.025	11.250	47.375	5.10	4.95	5.75
25	11.025	11.275	47.500	5.10	4.95	5.75
26	11.025	11.250	47.500	5.10	4.95	5.75
27	11.025	11.275	47.625	5.10	4.95	5.75
29	11.025	11.200	47.500	5.10	4.95	5.75
30	11.025	11.175	47.125	5.10	4.95	5.75
			AVERAGES FOR MONTH			
	11.087	11.258	46.815	5 071	4.921	5.750
Apr.			AVERAGES FOR WEEK			
3	10.963	11.096	45.467	5.033	4.883	5.750
10	11.058	11.179	46.250	5.017	4.867	5.750
17	11.275	11.392	47.083	5.100	4.950	5.750
24	11.071	11.313	47.304	5.100	4.950	5.750
Apr.			CALENDAR WEEK AVERAGES			
6	10.933	11.063	45.479	5.008	4.858	5.750
13	11.213	11.371	47.000	5.067	4.917	5.750
20	11.196	11.346	47.208	5.100	4.950	5.750
27	11.025	11.275	47.408	5.100	4.950	5.750

SILVER, GOLD AND STERLING EXCHANGE

1940	Sterling Exchange		Silver (c)		Gold	
Apr.	"Checks"	"90-day demand"	New York	London	London	(d) United States
1	354.5000	351.1250	34.750	20.4375	168s	$35.00
2	357.0000	353.7500	34.750	20.2500	168s	35.00
3	354.5000	351.3750	34.750	20.3750	168s	35.00
4	356.0000	353.0000	34.750	20.1875	168s	35.00
5	357.0000	354.0000	34.750	20.1250	168s	35.00
6	357.5000	354.5000	(e)	(e)	(e)	35.00
8	356.0000	353.0000	34.750	20.1250	168s	35.00
9	347.0000	343.5000	34.750	20.5000	168s	35.00
10	346.0000	342.7500	34.750	20.9375	168s	35.00
11	355.0000	351.7500	34.750	20.5625	168s	35.00
12	349.0000	345.7500	34.750	20.8750	168s	35.00
13	351.2500	347.8750	(e)	(e)	(e)	35.00
15	351.7500	348.7500	34.750	20.7500	168s	35.00
16	349.0000	345.6250	34.750	20.8750	168s	35.00
17	347.7500	344.2500	34.750	20.9375	168s	35.00
18	351.0000	347.6250	34.750	20.8750	168s	35.00
19	350.2500	346.8750	34.750	20.8750	168s	35.00
20	352.0000	348.2500	(e)	(e)	(e)	35.00
22	353.0000	349.2500	34.750	21.2500	168s	35.00
23	351.5000	347.2500	34.750	20.9375	168s	35.00
24	348.0000	343.7500	34.750	21.0000	168s	35.00
25	350.2500	346.0000	34.750	20.9375	168s	35.00
26	350.0000	345.7500	34.750	20.8125	168s	35.00
27	350.0000	347.7500	(e)	(e)	(e)	35.00
29	351.0000	346.7500	34.750	21.0000	168s	35.00
30	351.0000	346.8750	34.750	21.0625	168s	35.00
			AVERAGES FOR MONTH			
	351.817	.....	34.750	20.713	.....	35.00
Apr.			AVERAGES FOR WEEK			
3	3.54917	.....	34.750	.....	.....	.....
10	3.53250	.....	34.750	.....	.....	.....
17	3.50625	.....	34.750	.....	.....	.....
24	3.50958	.....	34.750	.....	.....	.....

Calendar week averages, New York Silver: 6th, 34.750; 13th, 34.750; 20th, 34.750; 27th, 34.750

(e) Not quoted (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Owing to the European War and the disruption of normal trade relations, our export copper quotations, since September, 1939, have been based largely on f.a.s. transactions, ex United States ports. To arrive at the f.o.b. refinery quotation deduct .05 from the f.a.s. basis for lighterage.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c per pound over the current market for Prime Western but not less than 1c over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c per troy ounce. Handy & Harman's quotation on newly-mined domestic silver, 999 fine was 70⅝c throughout April.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1940	Copper			Tin		Lead				Zinc			
	Standard		Electro	Standard		Spot		3 months		Spot		3 months	
April	Spot	3 months	Bid	Spot	3 months	Buyers	Sellers	Buyers	Sellers	Buyers	Sellers	Buyers	Sellers
1	Not quoted			245.7500	243.5000	Not quoted							
2	"	"		248.7500	246.5000	"	"						
3	"	"		249.5000	247.0000	"	"						
4	"	"		249.5000	246.2500	"	"						
5	"	"		249.5000	246.5000	"	"						
8	"	"		250.2500	247.7500	"	"						
9	"	"		250.7500	248.5000	"	"						
10	"	"		252.2500	250.0000	"	"						
11	"	"		252.2500	249.5000	"	"						
12	"	"		250.2500	247.7500	"	"						
15	"	"		250.0000	246.2500	"	"						
16	"	"		253.5000	248.7500	"	"						
17	"	"		255.0000	249.5000	"	"						
18	"	"		255.5000	249.5000	"	"						
19	"	"		254.0000	248.0000	"	"						
22	"	"		252.7500	247.0000	"	"						
23	"	"		253.5000	249.0000	"	"						
24	"	"		254.2500	249.2500	"	"						
25	"	"		255.0000	250.0000	"	"						
26	"	"		255.5000	250.7500	"	"						
29	"	"		254.7500	250.7500	"	"						
30	"	"		253.2500	248.7500	"	"						
Average for month				252.080									

Prices for tin are the official prices of the London Metal Exchange, in long tons (2240 lb.). Trading in other metals remained suspended.

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(May 1, 1940)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	19c.
Antimony, domestic, spot, lb	14.00c.
Bismuth, ton lots, lb	$1.25
Cadmium, commercial sticks, lb	80c.
Calcium, lb., ton lots 97 @ 98 per cent	Nominal
Chromium, 97 per cent grade, lb	89c.
Cobalt, 97 to 99 per cent, per lb	$1.50
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	27c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$38.00
Quicksilver, flask of 76 lb., 100 flasks or more	$171.00
Radium, mg. radium content	$25.00@$30.00
Selenium, 99.5 per cent, lb	$1.75
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75
Thallium, 100 lb. or more, lb	$6.50
Titanium, 96 to 98 per cent, lb	$5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 48 @ 50% Cr_2O_3 c.i.f. Atl. ports, long ton	$29.00@$30.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$4.75
Mesabi bessemer	$4.60
Old Range non-bessemer	$4.60
Mesabi, non-bessemer	$4.45
Lead (Galena) 80 per cent, Joplin, Mo., ton	$58.78
Manganese Ore, c.i.f. Atlantic ports, long ton unit of Mn:	
52 @ 55 per cent	(b) 49c.
50 @ 52 per cent	(b) 49c.
46 @ 48 per cent	(b) 47c.
Molybdenum Ore, 90%, per lb. of MoS_2, f.o.b. mines	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 65 per cent, duty paid	$23.00
Domestic, 65 per cent and upward	(a)$22.00@$23.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$37.50

(a) Prices at mines, small lots, usually several dollars less. (b) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3c.
Cobalt Oxide, 70 @ 71 per cent, lb	$1.84
Copper Sulphate, 100 lb	$4.60
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.42
Sodium Sulphate, bulk ton	$13.00@$15.00

ALLOYS

Berryllium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb	11c.
Ferromanganese, 78 @ 82 per cent, gross ton	$100.00
Ferromolybdenum, 55 @ 65 per cent Mo. lb. of Mo. contained	95c.
Ferrosilicon, 50 per cent, gross ton	$69.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$1.90@$2.00

NON-METALLIC MINERALS

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$700@$750
Crude No. 2	$150@$350
Spinning fibers	$110@$200
Paper stock	$40@$45
Shorts	$12@$16.50
Vermont	
Shingle stock	$57
Paper stock	$40
Cement stock	$25
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$6.50
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$6.00@$7.00
Domestic, abrasive, 80 @ 84 per cent	$13.00@$14.00
Dalmatian, 50 @ 55 per cent	Nominal
French, 56 @ 59 per cent	(a)$7.00@$8.00
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$14.50
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$21.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00
Dead-burned, f.o.b. Washington	$22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in.	30@35c.
2 x 2 in.	50@60c.
3 x 3 in.	$1.25@$1.35
3 x 4 in.	$1.50@$1.60
3 x 5 in.	$1.75@$2.00
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12c.
Silica, in bags, 325 mesh, ton	$18.00@$40.00
Sulphur, Texas, mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$9.00@ $9.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50
200 mesh, cream colored	$26.00

(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$23.50
Basic	$22.50
No. 2 Foundry	$23.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$34.00
Structural shapes, 100 lb.	$2.10
Bars, 100 lb.	$2.15

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1939	1940	1939	1940	1939	1940
January	42.750	34.750	20.305	21.892	466.775	395.442
February	42.750	34.750	20.370	20.935	468.472	395.652
March	42.750	34.750	20.280	20.763	468.370	375.212
April	42.750	34.750	20.031	20.713	467.778	351.817
May	42.750	.....	20.123	.....	467.988	.....
June	41.955	.....	19.505	.....	468.137	.....
July	34.944	.....	16.952	.....	468.031	.....
August	35.951	.....	17.719	.....	460.383	.....
September	36.956	.....	22.178	.....	398.820	.....
October	35.726	.....	22.736	.....	400.350	.....
November	34.750	.....	23.378	.....	391.457	.....
December	34.956	.....	23.263	.....	391.830	.....
Year	39.082	.....	20.570	.....	443.199	.....

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine, London pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		(a) Electrolytic	
	1939	1940	1939	1940	1939	1940	1939	1940
January	11.025	11.954	9.912	11.999	43.125	(b)	48.440	(b)
February	11.025	11.148	9.735	11.471	42.188	(b)	47.375	(b)
March	11.025	11.160	9.888	11.407	42.938	(b)	48.120	(b)
April	10.265	11.087	9.820	11.258	42.031	(b)	47.853	(b)
May	9.833	.....	9.738	.....	41.656	.....	47.528	.....
June	9.775	.....	9.738	.....	41.986	.....	47.528	.....
July	9.976	.....	9.944	.....	42.899	.....	48.863	.....
August	10.261	.....	10.211	.....	44.685	.....	50.409	.....
September	11.635	.....	11.685	.....	(b)	.....	(b)	.....
October	12.215	.....	12.491	.....	(b)	.....	(b)	.....
November	12.275	.....	12.929	.....	(b)	.....	(b)	.....
December	12.275	.....	12.631	.....	(b)	.....	(b)	.....
Year	10.965	.....	10.727	.....	(c) 42.689	.....	(c) 48.262	.....

New York quotations, cents per pound. London, pounds sterling per long ton, (a) Bid quotations. (b) No quotations. (c) Average for eight months.

LEAD

	New York		St. Louis		London			
	1939	1940	1939	1940	1939 Spot	1939 3 mos.	1940 Spot	1940 3 mos.
January	4.826	5.471	4.676	5.321	14.534	14.744	(a)	(a)
February	4.805	5.076	4.655	4.926	14.283	14.417	(a)	(a)
March	4.824	5.192	4.674	5.042	14.660	14.860	(a)	(a)
April	4.782	5.071	4.632	4.921	14.337	14.533	(a)	(a)
May	4.750	.....	4.600	.....	14.483	14.679	.....	.....
June	4.800	.....	4.650	.....	14.564	14.651	.....	.....
July	4.854	.....	4.704	.....	14.753	14.856	.....	.....
August	5.043	.....	4.893	.....	16.040	15.885	.....	.....
September	5.449	.....	5.299	.....	(a)	(a)	.....	.....
October	5.500	.....	5.350	.....	(a)	(a)	.....	.....
Novemoer	5.500	.....	5.350	.....	(a)	(a)	.....	.....
December	5.500	.....	5.350	.....	(a)	(a)	.....	.....
Year	5.053	.....	4.903	.....	(b) 14.707	(b) 14.828	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton. (a) No quotations. (b) Average for eight months.

TIN

	Straits New York		Standard, Spot London	
	1939	1940	1939	1940
January	46.404	46.707	215.435	240.716
February	45.640	45.851	213.906	242.833
March	46.213	47.079	215.375	251.711
April	47.160	46.815	218.389	252.080
May	49.031	.....	225.591	.....
June	48.853	.....	227.511	.....
July	48.548	.....	229.833	.....
August	48.793	.....	229.869	.....
September	64.588	.....	229.292	.....
October	55.580	.....	229.943	.....
November	52.322	.....	230.000	.....
December	50.740	.....	248.974	.....
Year	50.323	.....	226.177	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1939	1940	1939 Spot	1939 3 mos.	1940 Spot	1940 3 mos.
January	4.500	5.644	13.682	13.887	(a)	(a)
February	4.500	5.534	13.522	13.780	(a)	(a)
March	4.500	5.750	13.728	13.961	(a)	(a)
April	4.500	5.750	13.443	13.637	(a)	(a)
May	4.500	.....	13.717	13 938	.....	.....
June	4.500	.....	14.023	14.223	.....	.....
July	4.516	.....	14.235	14.435	.....	.....
August	4.719	.....	14.628	14.761	.....	.....
September	6.104	.....	(a)	(a)	.....	.....
October	6.500	.....	(a)	(a)	.....	.....
November	6.500	.....	(a)	(a)	.....	.....
December	5.980	.....	(a)	(a)	.....	.....
Year	5.110	.....	(b) 13.872	(b) 14.078	.....	.....

St. Louis quotations, Prime Western, cents per pound. London, pound sterling per long ton. (a) No quotations. (b) Average for eight months.

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1939 (a)	1940 (a)	1939	1940
January	58.400	79.638	20.000	20.000
February	55.000	80.000	20.000	20.000
March	54.259	80.000	20.000	19.769
April	50.000	80.000	20.000	19.000
May	50.000	.....	20.000	.....
June	50.000	.....	20.000	.....
July	50.000	.....	20.000	.....
August	53.704	.....	20.000	.....
September	64.200	.....	20.000	.....
October	74.600	.....	20.000	.....
November	75.000	.....	20.000	.....
December	75.000	.....	20.000	.....
Year	59.180	.....	20.000	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound. (a) Producers' price, commercial sticks.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1939	1940	1939	1940	1939	1940
January	11.670	14.000	77.440	156.962	34.440	40.000
February	11.250	14.000	85.227	178.000	35.000	40.000
March	11.269	14.000	87.278	180.921	35.000	40.000
April	11.500	14.000	90.800	173.538	35.000	38.923
May	11.712	.....	86.769	.....	35.000	.....
June	12.000	.....	86.615	.....	35.000	.....
July	12.000	.....	86.960	.....	35.000	.....
August	12.000	.....	84.407	.....	35.333	.....
September	12.910	.....	140.000	.....	40.080	.....
October	14.000	.....	145.600	.....	41.120	.....
November	14.000	.....	134.978	.....	40.000	.....
December	14.000	.....	141.200	.....	40.000	.....
Year	12.359	.....	103.940	.....	36.748	.....

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk 13.415 for April. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum, dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1939	1940	1939	1940	1939	1940
January	21.50	23.50	20.50	22.50	21.00	23.00
February	21.50	23.50	20.50	22.50	21.00	23.00
March	21.50	23.50	20.50	22.50	21.00	23.00
April	21.50	23.50	20.50	22.50	21.00	23.00
May	21.50	.....	20.50	.....	21.00	.....
June	21.50	.....	20.50	.....	21.00	.....
July	21.50	.....	20.50	.....	21.00	.....
August	21.50	.....	20.50	.....	21.00	.....
September	22.50	.....	21.50	.....	22.00	.....
October	23.50	.....	22.50	.....	23.00	.....
November	23.50	.....	22.50	.....	23.00	.....
December	23.50	.....	22.50	.....	23.00	.....
Year	22.083	.....	21.083	.....	21.583	.....

Iron, dollars per long ton. F.o.b. Mahoning and Chenango Valley furnaces.

PERSONAL ITEMS

H. W. Gould, of San Francisco, was in New York on business in late April.

C. Carleton Semple has been appointed general manager for Compañia Minas Matagalpa, Matagalpa, Nicaragua.

Richard Vail spent the past winter in Florida and is now back in York, S. C., where his address is 128 North Congress St.

Robert O. Jones, mining engineer with Westvaco Chlorine Products Corporation, Gustine, Calif., has been transferred to Battle Mountain, Nev.

W. R. Wade, consulting engineer, has left his San Francisco headquarters for Libby, Mont., where he is developing the Branagan gold mine.

N. H. Fisher has been appointed assistant government geologist of South Australia. He has hitherto been government geologist of New Guinea.

H. E. Munn has succeeded V. I. Mann in the position of underground manager of Mount Isa Mines, Ltd., Mount Isa, Queensland.

C. E. Gregory has relinquished the position of general superintendent of New Guinea Goldfields, Ltd., Wau, New Guinea, which he has held for two years.

N. Quisumbing, general manager, Amalgamated Minerals, Inc., Manila, P. I., has returned home from a business trip to New York.

V. I. Mann has been appointed general manager of Lake George Mines, Ltd., Captain's Flat, New South Wales. He was formerly underground manager of Mount Isa Mines, Ltd., Queensland.

J. C. Coldham, formerly general manager of Raub Australian Gold Mining Company, has charge of important construction work for the British Admiralty at Singapore.

John A. Burgess, general manager, Carson Hill Gold Mining Corporation, Melones, Calif., has been elected president of the newly organized Mother Lode Mining Association.

Earl K. Nixon, director of the Oregon Department of Geology and Mineral Industries, has been granted a leave of absence for an airplane trip to Peru, to investigate iron-ore possibilities.

H. Hart Pratley, Pasadena, Calif., has just completed some experimental tests in the lead-silver camps of Utah to measure the seismic wave velocities of ore in place, in contrast with the velocities of the including limestones and porphyries, using a portable seismograph unit which could be set up underground.

Dr. R. R. Sayers, who was detailed by President Roosevelt as Acting Director of the Bureau of Mines on April 5, is senior surgeon of the United States Public Health Service, in which organization he has served since 1914. From

DR. R. R. SAYERS

1917 to 1932 he was chief of the health and safety branch of the Bureau of Mines when that work was under the direction of the Public Health Service. Dr. Sayers is widely known in the field of industrial safety and hygiene. He is a member of the A.I.M.E. and numerous other scientific and professional societies.

L. R. Nielson, president and founder of the mine management and operating company in the Philippines which bears his name, arrived in San Francisco April 19. Mr. Nielson is on a six to eight months' business and vacation trip and intends to travel extensively throughout the United States and Canada. He will make his headquarters at his brokerage firm of L. R. Nielson & Company, 329 Bush St., San Francisco, Calif., during his stay.

L. R. NEILSON

W. J. Clough, until recently with the Cerro de Pasco Copper Corporation, Peru, S. A., has joined the staff of Idaho Maryland Mines Corporation at Grass Valley, Calif.

Dean Milnor Roberts and **Prof. Joseph Daniels** of the College of Mines, University of Washington, accompanied by university students, recently completed their annual inspection tour of the Britannia operations.

J. Murdock White has resigned the position of manager of Redbank Dredging, N. L., Redbank, Victoria. He has been succeeded by **W. R. Lomas,** late manager of New Campbell's Creek Dredging, N. L., Campbell's Creek, Vic.

Stavely Mason, mining engineer, recently left Noranda for Nicaragua, where he is associated with a new gold property, controlled by Noranda through a Nicaraguan subsidiary.

Cornelius F. Kelley, since 1918 president of Anaconda Copper Mining Company, was on April 30 elected chairman of the board of the company. **James F. Hobbins,** formerly executive vice-president, succeeds Mr. Kelley in the office of president.

O. B. Hart, general manager of Bulolo Gold Dredging, Ltd., left Australia for the U. S. A. recently on holiday leave. During his absence F. W. R. Godden is acting as general manager.

H. R. Connors has been appointed mill superintendent of Big Bell Mines, Ltd., Western Australia, succeeding **G. H. Cliff,** who has become assistant general manager of the company.

A. H. Millett, manager of operations at the property of St. John d'el Rey Mining Company, Ltd., in Brazil, for the last ten years, retires from his post this June. **Eric Davies,** who has been assistant superintendent for sixteen years, succeeds Mr. Millett.

Sylvester C. Buchanan is running milling tests on gold ores in the State of Jalisco, Mexico, for Eastern interests. His permanent address is Hidalgo No. 17, Guanajuato, Gto., Mexico.

A. Chester Beatty has been appointed a director of the English Commercial Corporation, Ltd., which has been formed by the British Government to trade with the Balkan countries. All the capital will be subscribed by the British treasury.

Ira B. Joralemon, consulting engineer of Bralorne Mines, whose home is in San Francisco, was in the Bridge River district making his annual survey of the Bralorne property preliminary to preparation of the company's recently issued 1939-40 report.

N. Bolitho, formerly inspector of mines for the Maryborough district, Victoria, has been appointed to the Bendigo district, succeeding **J. B. Justice,** who has retired from the public service. Mr. Bolitho's place at Maryborough has been taken by **A. R. O'Brien.**

Leverett Davis has resigned as vice-president in charge of operations of the Cornucopia Gold Mines to devote his time to the operations of the Simmons mine and others which he has acquired.

Mr. Davis will also be available for consulting work. His address remains Cornucopia, Oregon.

J. C. Kinnear, general manager, Nevada Consolidated Copper Corporation, McGill, Nev., has accepted the chairmanship of the program committee for the seventh annual metal mining convention and exposition of the American Mining Congress to be held at Colorado Springs, Colo., Sept. 16 to 20.

R. L. Kidd, assistant professor of ore dressing research, University of Utah, has been elected president of Sigma Gamma Epsilon, professional fraternity

R. L. KIDD

of men engaged in mining, metallurgy, and geology. He was previously vice-president of the fraternity's Western province.

Frank O. Jasmer, formerly resident manager of the Cia. Minera "the Golden Girl" S. A., of Nayarit, Mexico, is now with the Cia. Minera "Minas Artemisa" S. A., as resident manager. **Oliver O. Kendall** is president. Correspondence address Estacion Poza, FF. CCS. deM. Sonora, Mexico. Preparations are now being made to start the company's 200-ton mill.

Walter B. Lenhart, formerly mill superintendent for the Cardinal Gold Mining Company, Bishop, Calif., is now general superintendent of the Tungstar Corporation's mine, tramway, and mill on Pine Creek, near Bishop, Calif. **W. Bemis Phelps,** formerly general manager of the Tom Reed mine, Oatman, Ariz., is consulting engineer for the Tungstar Corporation.

Edwin Letts Oliver, president, Oliver United Filters, Inc., and **Charles W. Merrill,** president, The Merrill Company, were recently honored at a banquet in San Francisco given for Western inventors selected to receive the Modern Pioneer Award sponsored by the National Association of Manufacturers. The citations were for revolutionary cyanide filters patents and for metallurgical developments in gold and silver mining.

Herbert G. Moulton, president, A.I.M.E. and **Daniel C. Jackling,** past president, were guests of honor of the Chicago section at a President's night dinner-dance at the Blackstone Hotel on April 16. On the preceding day Mr. Jackling received the Washington Award of the Western Society of Engineers "in recognition of devoted, unselfish, and prominent service in advancing human progress."

Morris J. Elsing, who came back from Japan to his home in Tucson, Ariz., last December, after a stay of two and a half years in that country on consulting work, sailed once more for Japan on May 9, taking the "President Cleveland" from San Francisco. He expects to be gone several months.

T. H. Cain, formerly mining captain at the Alexandria Mine at Chisholm, Mich., is now in charge of underground mining for the Oliver Iron Mining Company in the Hibbing-Chisholm district. **Stanley Trengove,** of Hibbing, Minn., has been promoted to the position of assistant superintendent in the Hibbing-Chisholm district for the Oliver Iron Mining Company.

Archie O. Adams, master mechanic for Livengood Placers, Inc., has returned to Fairbanks, Alaska, and reports a 1½-yd. Lima dragline is en route for that company's operation on Livengood Creek, near Fairbanks. Other equipment is going in with the shipment and includes a 6-cu.ft. Yuba dredge.

Thomas S. McDougal, of Wasilla, Alaska, Fern Gold Mining Company's contractor, was in Spokane, Wash., in March, arranging the extension of the lease which he has held on the property for nine years. He was also securing equipment for a mill of 60 to 70 tons' capacity to replace the 20-ton plant which he has been using. A truck road to Goose Bay and a wharf at the shipping point have been built.

Joseph T. Sullivan and **Morton Sullivan** already have started their season's deep sea mining at Bluff, 50 miles east of Nome, Alaska. With their equipment on the ice they cut holes through which they lower their two-yard slack-line bucket to the bottom of the ocean and with a 280-hp. hoist, drag it back and forth. The rich ocean gravel is dumped by a "spar-tree" and a pump is used to run it through sluices.

F. L. LaQue, who has been New York assistant director of technical service on mill products for the International Nickel Company, is now engaged in development activities on all applications of both ferrous and non-ferrous nickel-containing alloys. **Dr. William A. Mudge,** formerly works metallurgist of the company's rolling mill at Huntington, W. Va., and who recently joined the technical service section of the development and research division of the company in New York, has been appointed assistant director of technical service.

Edwin Sweetman, director of the Engineers' Club of Northern Minnesota, was in charge of arrangements of the meeting of the Club on the evening of April 17 at Virginia, on the Mesabi range. **W. L. Taylor,** of Hibbing, president, occupied the chair. Approximately 150 were present, including many prominent mining men. The speaker of the evening was **G. Howard Spaeth,** State commissioner of taxation.

W. F. Netzeband has resigned from his position as engineer for the Tri-State Zinc and Lead Ore Producers Association, at Picher, Okla., to become plant superintendent for the Silica Products Company, Inc., of Batesville, Ark. The company has two plants for processing silica sand, mostly for glass manufacture. One is at Guion, about 25 miles northwest of Batesville, and the other at Everton, 15 miles southwest of Harrison. Mr. Netzeband left Picher on May 1.

Dr. Alfred K. Snelgrove, a member of the department of geology at Princeton University, will head the department of geology and mineralogy at the Michigan College of Mining and Technology at Houghton at the opening of the fall term. He is secretary of the Princeton department of geology and of the Princeton Geological Association. Outstanding achievements by Dr. Snelgrove in the last decade include his service, in the summer of 1931, as field assistant to the director of the Geological Survey of Canada and his supervision, for several summers, of the Princeton geological expeditions in Newfoundland.

▼ ▼ ▼

OBITUARY

Charles E. Morris, a Canadian mining engineer well known in the Kenora and Cobalt districts, died at Ottawa on April 6 at the age of 67.

Charles Adams, of San Francisco, a mining engineer widely known in Canada and Mexico as well as in the United States, died on April 27 at the age of 50.

Frank H. Probert, dean of the University of California College of Mining, and long prominent as a consulting mining engineer and educator, died at Berkeley, Calif., on May 7 at the age of 63.

James John Denny, chief metallurgical engineer with McIntyre Porcupine Gold Mines, Inc., died in Toronto on April 30 at the age of 55. Dr. Denny, in collaboration with **Dr. William D. Robson,** had conducted extensive experiments in the study of silicosis and the possible benefits of aluminum dust in atomized form as a preventive of silicosis infection.

▼ ▼ ▼

A LETTER

Amalgamated Minerals Production in 1938 and 1939

The Editor:

NORBERTO QUISUMBING, general manager of Amalgamated Minerals, Inc., has called my attention to the production table for base metals for the Philippines for 1939, which appeared in your February, 1940, issue. A production figure was given for his company for 1939 but not for 1938. Mr. Quisumbing has supplied me with the following figures for production, with the request that they be forwarded to you for publication if possible:

		Pesos
1938	9,548 tons	257,796.00
1939	10,082 tons	231,000.00

RALPH KEELER

Manila, P. I.

What Metal Statistics Show

OPERATIONS at domestic mines are continuing on a steady basis, but producers are beginning to view with ironical concern the growing uncertainty of world markets for metals as the European War spreads. Recent military events in Norway and Denmark has curtailed shipments of foreign copper and lead to those countries, including Sweden, thereby, temporarily at least, restricting these markets. Shipments of domestic copper abroad have declined and the outlook, in early May, remained obscure. Supplies of domestic copper have been increasing and unless demand for metal improves, some in the industry believe producers may have to take action on curtailment. This of course depends on the influence of the war that many believe is destined to spread.

The March statistics of the Copper Institute showed that stocks of refined copper increased 14,402 tons during the month. Members of the industry differed in their interpretation of the figures, as usual. Those who are optimistically inclined viewed total stocks of refined of 159,795 tons as still on the low side. Others believe that production will have to be curtailed unless consumption of domestic metal increases soon. Export trade in domestic copper has been shrinking, the figures reveal.

The figures for February and March, in tons, follow:

	Feb.	March
Production:		
Crude	(a)76,145	85,466
Refined	82,761	86,295
Deliveries:		
Domestic	63,215	64,376
Export	9,594	7,517
Totals	72,809	71,893
Stocks, refined	145,393	159,795

(a) Corrected.

Estimated copper content of shipments ex mills of all kinds and ex foundries, allowing for normal return of processing scrap, according to the American Bureau of Metal Statistics, follows:

	1939	1940
January	58,500	74,000
February	53,500	65,000
March	58,000	68,000
April	53,000	.....
May	54,000	.....
June	55,000	.....
July	54,000	.....
August	63,000	.....
September	73,000	.....
October	84,000	.....
November	82,000	.....
December	71,000	.....
Total	759,000	.....

▶ ZINC — The February, March, and April statistics of the American Zinc Institute, covering all grades, are summarized as follows in tons:

	Feb.	March	April
Stock at beginning.	65,602	67,086	72,611
Production	54,532	57,620	54,601
Production daily rate	1,880	1,859	1,820
Shipments	53,948	51,095(a)	46,978
Unfilled orders	47,496	34,580	45,326
Stock at end	67,086	73,611	81,234

(a) Includes 386 tons exported.

Figures covering operations of the Prime Western division, for February, March and April, follow:

	Feb.	March	April
Stock at beginning	26,812	28,484	32,179
Production	23,687	25,103	22,962
Shipments	22,015	21,408	19,883
Stock at end	28,484	32,179	35,258

▶ LEAD—Production of refined lead during March was a little larger in volume than expected and deliveries to consumers were somewhat smaller than estimated, with the result that stocks increased 2,034 tons. The small gain in stocks had no influence on the market.

Domestic shipments of 46,353 tons for March compare with 39,176 tons shipped in February and 39,875 tons in January. Total production was 48,400 tons during March, against 43,317 tons in February and 49,683 tons in January.

The February and March statistics for refined lead, according to the American Bureau of Metal Statistics, in tons, follow:

	Feb.	March
Stock at beginning	68,539	72,658
Production:		
From domestic ore	40,564	44,783
Secondary and foreign	2,753	3,617
Totals	43,317	48,400
Domestic shipments	39,176	46,353
Stock at end	72,658	74,692

On May 6 the price of domestic lead declined from 5.10c. to 5c. per pound. This action was believed influenced by the accumulation of foreign lead seeking to replace the Scandanavian market that is gradually being forced into the German economic sphere of influence.

▶ MANGANESE—Domestic production of manganese ore containing 35 per cent or more manganese (natural) during the month of February was 5,100 long tons, shipments were 5,600 tons, and producers' stocks at the end of the month were 1,500 tons, according to the United States Bureau of Mines. These figures are predicated on reports received from producers that accounted for 86 per cent of the total in 1938. In January production and shipments were 4,000 tons and producers' stocks at the end of the month were 2,000 tons.

▶ QUICKSILVER—Domestic output of quicksilver took a sharp upturn in February, according to the latest survey by the Bureau of Mines, United States Department of the Interior, when 2,200 flasks were produced, compared with 1,800 flasks in January and a monthly average of 1,499 flasks in 1938. Domestic consumption of quicksilver amounted to 2,000 flasks in February, against 2,300 flasks in January.

A summary of the statistics for January and February, in flasks of 76 lb. each, follows:

	Jan.	Feb.
Production, U. S. mines	1,800	2,200
Imports (a)	147	3
Exports	151	115
Consumption	2,300	2,000
Consumers' stocks	10,900	10,200
Dealers' stocks	2,100	1,200
Producers' stocks	582	346

(a) Imports for consumption.

The report for February states that a sudden jump in imports of mercury compounds occurred in February, chiefly from Italy. According to the Bureau of Foreign and Domestic Commerce, imports of chloride of mercury totaled 18,710 lb. in February, against 6,700 lb. in all of 1939; oxide 9,000 lb., against 18,200 lb., respectively; mercury preparations not specially provided for, 14,700 lb., against 15,000 lb., respectively. Quicksilver exports from Italy were placed under government control in February and heavy export taxes were imposed.

▶ SILVER—Following is a preliminary estimate of world's production of silver, on refinery basis, according to the American Bureau of Metal Statistics, in fine ounces:

	1938	1939
United States	58,736,000	57,808,000
Canada	22,445,000	23,614,000
Mexico	81,017,000	75,849,000
Peru	20,500,000	18,689,000
Other America	17,800,000	19,125,000
Europe	22,230,000	22,180,000
Australia, etc. (a)	15,059,000	15,649,000
Japan (b)	10,000,000	10,500,000
Burma	5,920,000	6,175,000
Other Asia	4,695,000	4,885,000
South Africa	1,135,000	1,179,000
Belgian Congo	3,122,000	2,815,000
Other Africa	1,431,000	1,445,000
Totals	264,090,000	259,913,000

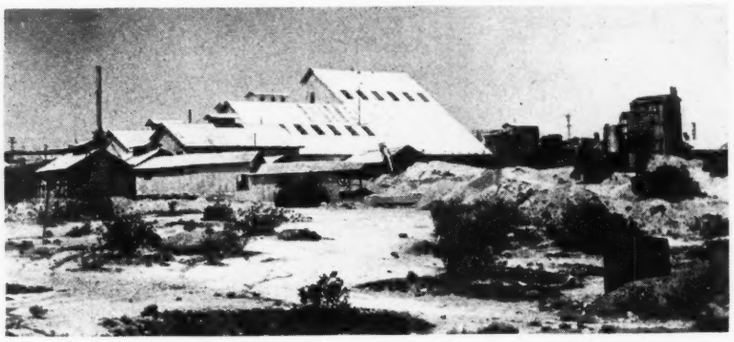
(a) Includes New Zealand. (b) Conjectural.

E & M J Weighted Index of Non-Ferrous Metal Prices

(100 is composite for 1922–3–4)

1929	110.33	1934	69.59
1930	82.87	1935	74.66
1931	60.20	1936	73.45
1932	48.26	1937	90.86
1933	59.79	1938	73.67
1939	77.71		

	1938	1939	1940
January	75.56	77.12	80.85
February	73.43	76.89	77.23
March	72.41	77.09	77.94
April	71.19	74.79	77.19
May	69.15	73.61	.....
June	67.55	73.17	.....
July	72.95	71.95	.....
August	73.94	73.88	.....
September	74.70	83.07	.....
October	77.61	84.25	.....
November	78.36	83.80	.....
December	77.13	82.89	.....



Remodelled mill of the Atolia Mining Company, Calif., for concentrating tungsten ores. Treatment includes crushing, grinding, tabling, flotation, roasting, electric separation, and acid leaching. The volume of production depends on the tungsten market

CALIFORNIA

Old South Empire Shaft Being Reopened

Argonaut Mining Company, Ltd., plans rehabilitation of Plymouth Consolidated property, in Amador County—Mill operations at Zeibright mine suspended when heavy rainfall washes out tailings dump

▶ According to word received from Alex. F. Ross, superintendent, Argonaut Mining Company, Ltd., has started to reopen the old South Empire shaft of the Plymouth Consolidated mine, at Plymouth, Amador County. The property, first known as the Empire and Pacific and later the Plymouth Consolidated, was ravaged by fire in 1888, resulting in flooding the underground workings late that year. Remaining idle until 1911, the mine was reopened by an English company. The present company acquired the holdings in 1925, and after exploration, milling suspended operations in 1928. Rehabilitation work will be carried out by a relatively small crew, with monthly profits from the tailings plant being used to finance the cost of reopening the property. The work is directed by Mr. Ross, and Hal M. Lewers, superintendent of the Plymouth tailings plant, is in charge of operations.

▶ Milling operations at the Zeibright mine, near Emigrant Gap, Nevada County, have been suspended following washout of the tailings dump during recent heavy rains. Development is proceeding underground, but the 1,000-ton concentrator is not expected to be reopened until some permanent solution of the tailings problem has been found. About 85 men are employed. Several groups of leasers are working at the Murchie mine, near Nevada City, and the 6,000-ft. Banner crosscut is being advanced at the rate of about 25 ft. a day. It is now within 3,000 ft. of its objective. At the Pennsylvania mine, near Smartville, Yuba County, operations are on a straight development basis, though milling of excess development ore is done whenever the bins are filled. All properties are operated by Empire Star Mines Company, Ltd., and Robert J. Hendricks, manager, directs operations.

▶ Dewatering operations as a preliminary to sampling and development are in progress at the Jenny Lind mine, formerly known as the Washington, near Hornitos, Mariposa County. The property is operated by the Pacific Mining Company, directed by P. R. Bradley, Jr., owner of the Pine Tree and Josephine properties in Bear Valley, Mariposa County.

▶ A revolving gravel-washing plant capable of handling 1,500 cu.yd. a day has been completed on Cincinnati Creek, El Dorado County, by A. D. Hadsel, of Irish Creek Mining Company. The company has recently taken leases on properties owned by George Croft, the Hakemoller Estate, Harry van de Water, Dudley Davenport, and Guy Davenport, covering about 1,200 acres. Gravel will be mined by a ¾-cu.yd. gas shovel discharging onto a conveyor belt leading to the washing plant. Operating crew numbers about fifteen men.

▶ Gold Butte Mines, Inc., is completing installation of a 30-ton milling plant at its property near Berry Creek, Butte County, where a small crew of men is at work developing a 6-ft. vein of good milling ore. John W. Ross is president of the company.

▶ Rehabilitation work is in progress at the Independence and Starlight properties, southwest of El Dorado, El Dorado County, operated under a bond and lease agreement by the Madre de Oro Gold Mines, Inc. The company has also commenced exploration of its holdings in the Kelsey area covering about 640 acres situated near the famous Alhambra mine. Forrest Riley heads the company, and operations are directed by William J. Loring, general manager and consulting engineer.

▶ B. N. Rosenbaum, of New York City, has taken an option on the Davenport property, near Auburn, Placer County, and active operations are expected to commence in May. The mineral holdings cover some 160 acres, and development will proceed from two tunnels. A small mill is available, and a second unit is to be installed following completion of metallurgical tests.

▶ Dredging operations with a new Bodinson dragline dredge capable of handling 4,000 cu.yd. a day are scheduled to start early in May on the J. M. Allen and Grant Smith properties, near Happy Camp, Siskiyou County, acquired recently by Happy Camp Dredging Company. The company is headed by A. L. Merritt, of San Francisco, and operations will be directed by G. I. Dumond, superintendent.

▶ Central Eureka Mining Company, C. C. Prior, president, has adopted a dividend policy of 8c. bi-monthly for 1940, declaring the first dividend for payment April 15. The company has disbursed 6c. bi-monthly since 1938, with year-end extras. Improvements soon to be made at the company's mill at Sutter Creek, Amador County, include installation of a new ball mill and auxiliaries to effect finer grinding and permit an increase in tonnage whenever required. James Spiers is general superintendent.

▶ After a year of considerable development work, the operators of the Densmore mine, near Columbia, Tuolumne County, have decided to install a 50-ton cyanide plant, and accordingly have let a contract to O. J. Scherer, of Angels Camp, with Mines Engineering & Equipment Company, San Francisco, furnishing milling machinery. The plant is expected to be in operation early in June. Crosby E. Keen is general manager and Marc L. Latham, metallurgist.

▶ Work of reopening the Oceanic quicksilver mine, near Cambria, San Luis Obispo County, is proceeding according to schedule and active exploitation is expected soon. The property is owned by the Anglo-American Mining Corporation, 206 Sansome St., San Francisco, and was leased recently to A. J. Bruce, of Los Angeles. Reduction equipment available includes a 70-ton rotary furnace.

ARIZONA

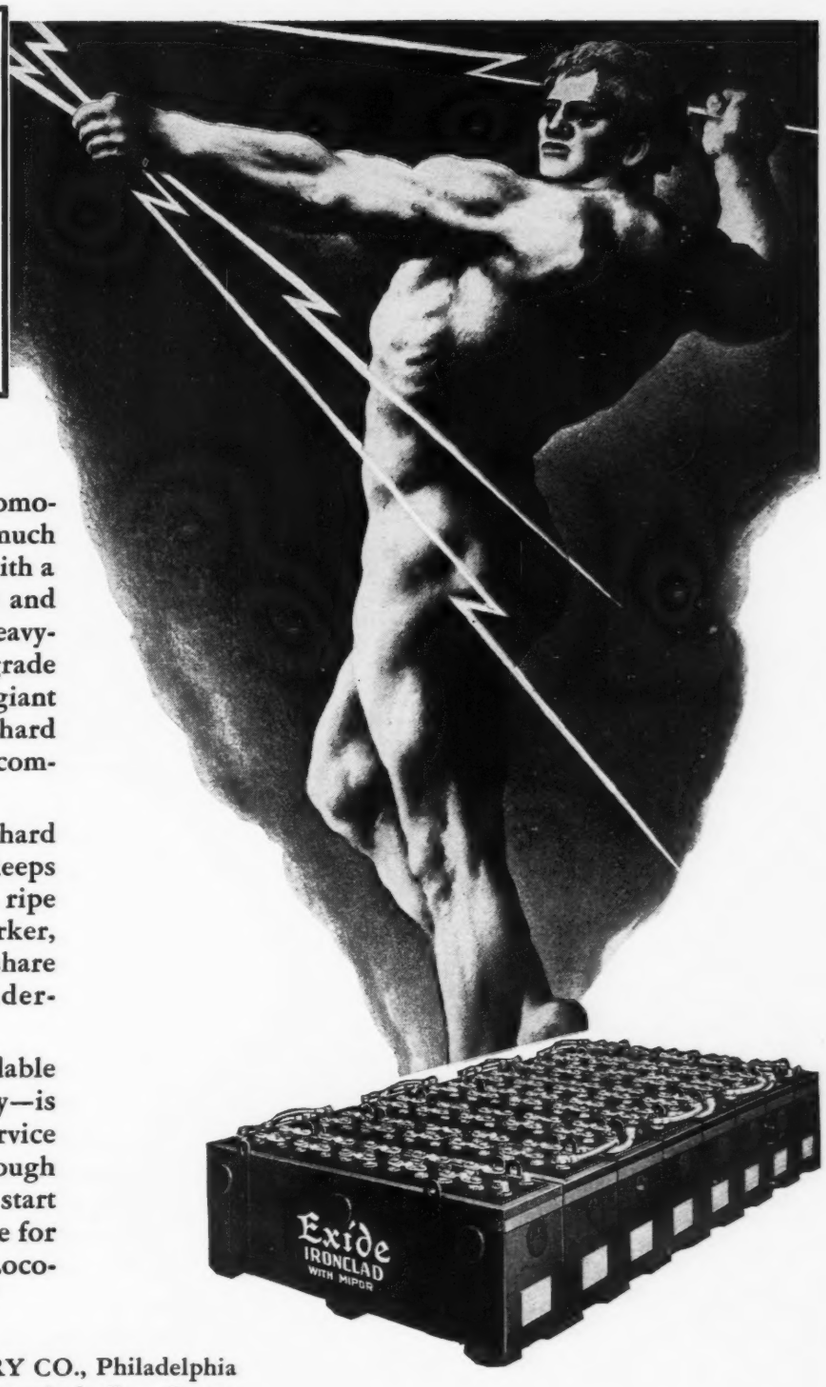
Development of Moss Mine Gets Under Way

Tonopah Mining Company obtains encouraging results in rehabilitation of old gold property — Tungsten mine to be exploited by Continental Mining Company

▶ The Tonopah Mining Company has taken over the old Moss mine situated in the Silver Creek country of the River range in Mohave County. W. R. Hellier and R. M. Kellogg have been superintending operations for the past eight months. Some substantial bodies of gold ore are said to have been determined and the company is planning extensive development work. H. A. Johnson is general manager of the Tonopah Mining Company.

▶ The Continental Mining Company, of New York, which recently took over the Ed. Williams tungsten property in Francis Creek country, in Mohave County, have established their camp on the property and machinery is en route. Dr. Felix Ochs, engineer for the com-

The giant that lives in a box...



AN EXIDE-IRONCLAD locomotive or trammer battery looks very much like a black box . . . but it is a box with a giant inside it. A giant of strength and endurance, who can take a train of heavy-laden cars and push them up a grade while scarcely exerting himself. A giant who can start in the morning, work hard and fast all day, and end up just comfortably tired.

He is a durable giant, used to hard knocks and rough usage. And he keeps the full strength of youth far into a ripe old age. He is a willing, faithful worker, and he does, in fact, perform a large share of the nation's haulage work underground.

This giant—the tireless, dependable power of an Exide-Ironclad Battery—is waiting to speed up your haulage service and production. He is confident through long experience . . . and eager to start work for you, beginning now. Write for free booklet, "The Storage Battery Locomotive for Underground Haulage."

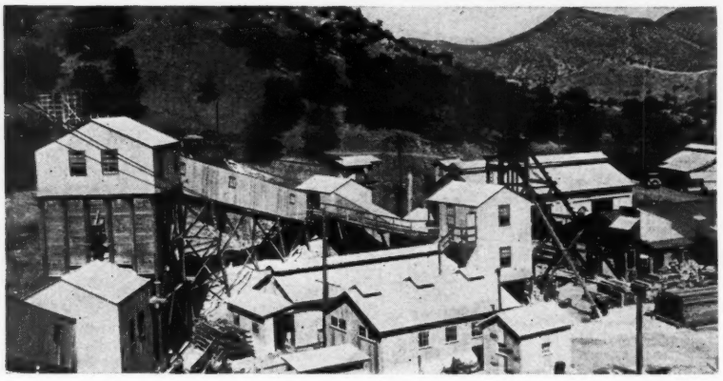
THE ELECTRIC STORAGE BATTERY CO., Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

EXIDE BRANCH OFFICES

ATLANTA—210 Walker St., S.W.
BOSTON—100 Ashford St.
CHICAGO—4613 S. Western Ave. Blvd.
CINCINNATI—718-19 Temple Bar Bldg.
CLEVELAND—6400 Herman Ave., N.W.
DALLAS—1118 Jackson St.
DENVER—810-14th St.
DETROIT—8051 W. Chicago Blvd.
KANSAS CITY, MO.—129 Belmont Blvd.

Exide
IRONCLAD
BATTERIES
With Exide **MIPOR** Separators
"MIPOR," Reg. U. S. Pat. Off.

LOS ANGELES—1043 S. Grand Ave.
MINNEAPOLIS—617 Washington Ave., N.
NEW ORLEANS—428 Baltar Bldg.
NEW YORK—23-31 W. 43rd St.
PHILADELPHIA—Allegheny Ave. and 19th St.
PITTSBURGH—1078 Union Trust Bldg.
ST. LOUIS—1218 Olive St.
SAN FRANCISCO—6150 Third St.
SEATTLE—1919 Smith Tower Bldg.
WASHINGTON—1819 L Street, N.W.



The Josephine shaft and crushing plant at the Trench mine of the American Smelting & Refining Company near Patagonia, Ariz. The lead ore is treated in a 200-ton flotation plant

▶ARIZONA

pany, is in active charge of operations. Much road work has already been done and work in the mine will now be prosecuted.

▶ E. E. Coate, of Dayton, Ohio, who recently took over the Cleopatra mine, in the Bill Williams River section in Mohave County, has been directing a drilling project on the property. Reports indicate that results show a blanket of ore in the massive limestone of that particular locality.

▶ Pruducers, Inc., operating the old Pilgrim property near Chloride, in Mohave County, have virtually completed arrangements for the operation of a property in Searchlight, Nev., the ores from which property will be trucked across the Boulder Dam to the mill of the Producers company.

▶ The Simonds Screen Company, which recently optioned the Silver King mine, situated 12 miles easterly from Kingman, in the north end of the Hualpai Mountains, is driving steadily forward along the caved area in the old property and expects to cut back into the old workings in a few more shifts. The Silver King produced some rich silver ore 30 years ago, but has been idle of late years. The company, also, has taken over the Columbus and Lead Carbonates properties situated just south of the Silver King. Frank Walker was owner of the Columbus and Lead Carbonate properties. The company expects to commence operation here also.

▶ A group of ten claims known as the E. H. C. group owned by Mrs. Jennie B. Hayes, of Cordes, Ariz., has been purchased by the Prudential Gold Mines Company, of Pasadena. The property is in Turkey Basin near Cleator. A diamond drilling program is planned and prior developments have disclosed a good tonnage of commercial ore. The company is headed by A. D. Frazer and associates; of Pasadena, Calif. H. L. Zebold, of Cleator, is in charge of operations.

▶ At the Polaris mine, 8 miles north of Clifton, a compressor has been installed and some men are employed on preliminary work, under the direction of J. W. Buckley. The property is owned by J. A. Hagen, of Clifton, and is under option to the Polaris Mining company of Salt Lake City, Utah.

▶ John McLondon, of Morenci, has taken a three-year lease on the Sweeting property, a mile north of Clifton, and has a crew sorting high-grade ore.

▶ Greg DeGrozia is directing a crew of men mining gold, silver, and copper ore from the properties of the Dover Copper Company. The ground is situated in Gold Gulch about two miles northwest of Morenci. Other properties in Gold Gulch are being worked by leasers.

▶ Erection of a washing plant and installation of a mechanically agitated sluice has been completed at the Prince placer mine, on Lynx Creek, by J. M. Lafferty and J. E. Wenger, of Prescott. The plant is handling 300 cu.yd of gravel in sixteen hours, according to reports. A quarter-yard shovel is used in moving the bedded gravel.

▶ The Arizona Apex mine, 12 miles north of Hayden, idle for several months, has been reopened by T. J. Anderson, of Hayden Junction. At present a carload of ore is being shipped to the Hayden smelter each week. The property is owned by Fred Muller and H. C. Muller, of Los Angeles, Calif.

▶ The Ruth mine, 8 miles south of Prescott, is being rehabilitated and mining is under way on a small scale. The mine was unwatered and reopened by H. Stump, of Prescott, and is being operated under lease from Bert N. Meacham, of Long Beach, Calif. About 10 tons of ore are being produced daily and treated in the mill on the property.

▶ Shipments are expected to begin soon from the Vindicator group of claims situated 20 miles southwest of Globe. High-grade silver has been encountered. John A. Clark, of Globe, is owner of the property.

▶ During 1939 119,839 tons of ore was mined from the Denn mine of the Shattuck Denn Mining Corporation and treated, from which there were recovered 13,181,630 lb. of copper, 7,071 oz. of gold, and 236,955 oz. of silver. Development work was carried on continuously on several levels, and though no discoveries of major importance were made, substantial extensions of and additions to the known orebodies were disclosed. Associated with the copper ore are considerable bodies of lead-zinc ore, and the board of directors authorized the repair and renovation of the old Shattuck concentrating mill, situated near the Denn shaft, to treat the lead-zinc ores. At the date of this report the work at the mill has been completed and the mining and milling of these ores has begun. Thomas Bardon is president.

UTAH

Discussion of Contracts Sought by Miners' Union

Labor agreement expires June 30 and negotiations with operators are expected to start soon—Lehi Tintic Mining Company plans resumption of work

▶ Utah operators have been notified by R. O. Bunting, district president-secretary, International Union of Mine, Mill and Smelter Workers, that the union would ask for a reopening of the wage contract which expires on June 30, 1940. The union said that it may ask for changes in any provision, and all provisions, of the agreement. Negotiations will likely be opened before the present contract expires.

▶ North Lily Mining Company, with a production of 4,881 tons of ore from the North Lily and 11,736 tons from the Tintic Bullion leases, had a net loss of $6,570 in 1939. Ohio Copper had a net operating and miscellaneous profit of $20,508.98 but a net loss of $43,976.99 after depletion and depreciation. Production of copper, gold, and silver was valued at $183,254.

▶ The Park City Consolidated Mines, with a production of 55,631 tons, valued at $466,581.23 after smelter costs, reports a net loss of $120,985, deducting $69,987.18 for depletion, in 1939.

▶ The Elton Tunnel of the National Tunnel & Mines Company, which is being advanced at the rate of 20 to 25 ft. daily, has been extended about 13,500 ft. About 11,000 ft. of driving remain before it attains its objective. Barring any unusual event, the tunnel should be completed about August, 1941. Bingham Canyon properties of the company produced, in 1939, 17,986 dry tons of copper ore, 1,604 tons of lead ore, and 17,559 tons of lead-zinc ores, which resulted in an operating loss, before depreciation and depletion, of $54,882 and net income of $10,796 after depletion.

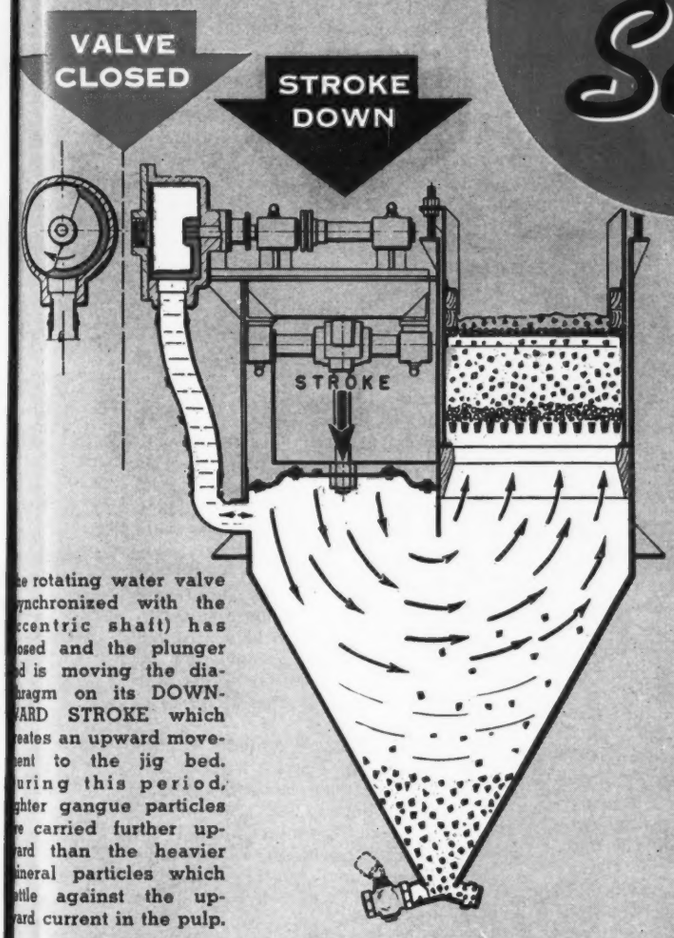
▶ After nearly two years of idleness, work is to be resumed at the Lehi Tintic mine, near Eureka, on the 900 level, George Nicholes, president, announces.

▶ Shipments have been started at the Pacific mine in American Fork Canyon, from an 8-ft. fissure carrying 16 in. of $65 silver-lead ore on the hanging wall and 6 in. of the same type of ore on the footwall.

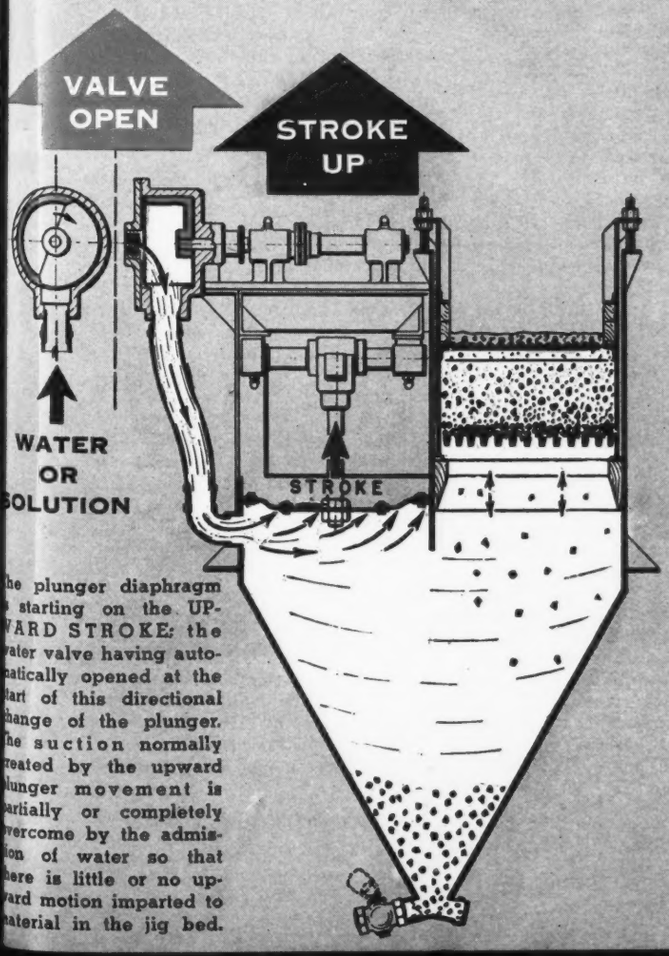
Pulsating Selector

Not Just Another Jig

•PRINCIPLE OF THE DENVER MINERAL JIG



e rotating water valve ynchronized with the ccentric shaft) has losed and the plunger d is moving the dia-hragm on its DOWN-ARD STROKE which eates an upward move-ent to the jig bed. uring this period, ghter gangue particles e carried further up-ard than the heavier ineral particles which ttle against the up-ard current in the pulp.



he plunger diaphragm starting on the UP-ARD STROKE: the ater valve having auto-atically opened at the art of this directional hange of the plunger. he suction normally reated by the upward lunger movement is artially or completely vercome by the admis-ion of water so that here is little or no up-ard motion imparted to aterial in the jig bed.

YOUR COPY OF THIS *Profit Making* BULLETIN NO. J2-B IS READY *Airmail Now*

PROVED LAB JIG
which will give definite data to base sound conclusions for the treatment of many ores. Every mill laboratory should have one.

12 FLOWSHEETS
from operating plants treating gold, lead, zinc, copper ores, and non-metallics. Improve your results with these flowsheets.

500 OPERATING
Denver Mineral Jigs are in the field . . . saving values both fine and coarse in a high grade product with minimum dilution.

NEW YORK, NEW YORK 50 Church St.
SALT LAKE CITY, UTAH McIntyre Bldg.
CHICAGO Suite 1005, 69 W. Washington St.
TORONTO, ONTARIO 45 Richmond St. West
MEXICO, D.F. Boker Bldg., 16 de Septiembre
JOHANNESBURG, SO. AFRICA 8 Village Rd.
MIDDLESEX, ENG. 493A, Northolt Road So. Harrow

DENVER EQUIPMENT 24 HOUR SERVICE COMPE
STANDARD RELIABLE 24 HOUR SERVICE EFFICIENT

DENVER EQUIPMENT COMPANY
1400 17TH ST., DENVER, COLO

NEWS FROM Washington

By Special Correspondent

INTERNATIONAL AND POLITICAL questions are interwoven in Washington to an amazing extent. And the snarl of those two types of problems threatens to influence many economic and technical matters of great importance to mining and the metal industries. Perhaps at no time before has the business executive and the engineer been so restrained or influenced by these factors. Many of the industry decisions which most people think should not hinge on Washington action now are so affected.

(Our Washington interpreter, who has a thirty-year acquaintance with the technology and economic movements of Washington, reports that never in three decades has there been so complicated "a mess." This situation leads him to discuss many political and social questions in these columns that normally would not find place here.—EDITOR.)

The decisions of the President, the Secretary of State, and other executive officials dealing with foreign affairs have in past administrations been largely uninfluenced by mere partisan consideration. Even in the campaign year of 1916, when Woodrow Wilson was reelected because "he kept us out of war" the issue presented to voters was that of an accomplished fact. Now the situation is very different. Every move made administratively is carefully weighed as to its influence on votes. Then when the decision is made and announced, the presentation to the public is equally a considered form, planned to woo voters for next November. And the legislative decisions of the members of Congress are equally involved. An appreciation of these facts is important when one attempts to understand why certain actions are taken and what effect they will have on the business man in his dealings with money, labor, taxes, and the other economic factors which determine balance sheet results in every division of industry.

New Bureau Personnel

SEVERAL IMPORTANT CHANGES in the personnel of the Bureau of Mines were announced during April. A new Acting Director was named, and changes at the top of the Economics Branch became effective.

The mining industry has greeted with both disappointment and satisfaction the naming of Dr. R. R. Sayers as the Acting Director of the Bureau. The satisfaction is based on the fact that the naming of this outstanding authority on health and mining safety virtually defeated Secretary Ickes in his effort to exercise political control of the Bureau through the removal of Dr. Finch. The disappointment comes from the failure to name a mining engineer or economic geologist of long "practical" experience in the industry.

Dr. Sayers is well liked personally both in Washington and throughout the mining field. His fifteen years' service as head of the health and safety branch of the Bureau unquestionably qualifies him as one acquainted with many of the problems of the industry. Those who know him are outspoken in the opinion that he will be no rubber stamp for the political manipulators who advise Secretary Ickes.

It should be noted that Dr. Sayers is merely Acting Director. This may mean either of two things, and Washington can only speculate as to which. Dr. Sayers may serve until well into 1941, thus postponing until after the next Presidential inaugural the naming of a permanent Director. That seems the most probable interpretation.

The second possibility, only whispered in most Washington discussions, is that this appointment is a ruse to allay Senatorial suspicions. Those who so charge reason thus: Dr. Sayers may serve only until after Congress adjourns. Then the President, at Secretary Ickes' request, could make a recess appointment of a new Director without having to confront the numerous outspoken critics of the Senate. Such recess appointee would serve through the next session of Congress, if the next President should so choose, even though the Senate might fail to ratify the nomination, which, of course, would be submitted for such action in January.

This charge of subtle indirection against the Secretary does not seem very credible. To accept it, one must also assume that the Secretary could "use" such new appointee to accomplish his avowed purposes of further regimentation of the mining industry, irrespective of Congressional wishes. That seems unlikely. The Secretary must have new legislation to carry out most of his desired changes in mining and metallurgical control. And to have such legislation handicapped by the presence of a director unacceptable to the Senate would be very poor politics.

The retirement for reasons of personal health of James W. Furness, who has been chief of the Economics Branch, became effective May 1. E. W. Pehrson immediately assumed the responsibility of chief of the metal economics division. And it is expected that he will, at least for a short time, serve as acting chief of branch. It seems likely that so long as Dr. Sayers is merely acting Director, he may not choose to name a new permanent chief of branch. It is also thought possible that no permanent assistant director will be named to succeed J. H. Hedges. Some staff member can well serve as acting assistant director. Such postponements would leave a new Director, when named, free to name his own major staff members. That is a privilege which most observers think a new Director should have.

Hemisphere Problems

OF OUTSTANDING CONCERN to mining among the Western Hemisphere problems is the debate between Washington and Mexico City about the right of foreign property owners in Mexico. The action of early April by Secretary Hull proposing arbitration of the oil industry expropriation appears a confession that our diplomatic representations have utterly failed. Some Washington observers fear that this confession may appear to Mexican authorities an evidence of weakness. Secretary Hull cannot have failed to take that possibility into account. Hence, it must be assumed that the arbitration plan was the least objectionable of those open to him.

Washington did not expect an acceptance of this proposal at this time. In fact, many regard the Secretary's note as merely "for the record." But this whole situation may change as a result of the charges that Mexico is seriously threatened by a revolution originating in Communist and Nazi activity. Certainly the present federal leaders of Mexico would much prefer to retain power, after important concessions to the United States, than to be confronted by a serious revolution accompanied by sabotage and destruction of important railways, mining, and mineral processing properties.

Washington is much amused at the prompt recognition by the British and some other European spokesmen that Greenland lies within the scope of the Monroe Doctrine. Greenland has little important significance to the mining industry, except for cryolite. A Danish government-owned company produces cryolite from the only commercially worked deposit of the world. Recent output has been about 50,000 metric tons per year, with exports to Denmark of about 60 per cent of this, valued at about a million dollars. The United States and Canada have taken the remainder for their aluminum industries.

Will Zinc "Escape"?

THE MINING INDUSTRY spokesmen in Washington have probably made more of an impression at the State Department regarding the inequities of trade pacts than any other business representatives except possibly one, red cedar shingles. The Department is frankly worried even yet about zinc. And all the world knows that the Department had to back up on the proposed cut in the copper excise tax or it surely would have lost its battle for extension of the authority to negotiate agreements.

The Canadian agreement includes the usual escape clauses. These are intended to provide either country with the privilege of reopening any one or more parts of the agreement under certain circumstances. Particularly these clauses provide that agreements shall be reconsidered if some third nation is found to be getting the major benefit of a cut in tariff granted by either party.

Mining industry spokesmen seem to have made a very persuasive case that

The LESCHEN Proving Ground

A section of the Leschen Laboratory where wire is being tested to determine its fitness. In this department are many other instruments, among which is an 800,000 pound capacity machine for determining the actual breaking strength of completed wire ropes.

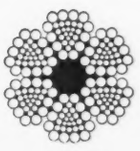
Rigid tests leave nothing to chance

"HERCULES" (Red-Strand) Wire Rope owes much of its outstanding performance record to the many rigid tests that must be undergone and survived, even before its actual manufacture begins.

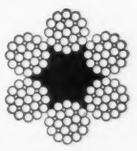
In reality our entire plant is a proving ground from receiving door to shipping platform. Following the thorough testing of all materials, exacting inspections are made by experienced workmen during each step in the process of manufacture.

Your proving ground for wire rope is where you use it. Because of our accurate control of quality during manufacture, you can depend on "HERCULES" (Red-Strand) Wire Rope for maximum operating economy. And it is on the job . . . *your* proving ground . . . where "HERCULES" has won and where it continues to maintain its enviable reputation.

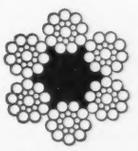
The illustrations at the right show a few of the many constructions in which "HERCULES" is available. All can be furnished either Standard or Preformed. We would welcome the opportunity to recommend the construction and type we consider most suitable for your conditions.



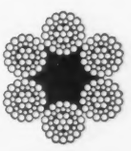
Style G
Flattened Strand



6x19
Filler Wire



6x19
Seale



6x37
Type

A. LESCHEN & SONS ROPE CO.

WIRE ROPE MAKERS — ESTABLISHED 1857

5909 KENNERLY AVENUE — ST. LOUIS, MISSOURI, U. S. A.

NEW YORK . . . 90 West Street
CHICAGO . . 810 W. Washington Blvd.
DENVER . . . 1554 Wazee Street

SAN FRANCISCO . . 520 Fourth Street
PORTLAND . . 914 N. W. 14th Avenue
SEATTLE . . 3410 First Avenue South

zinc should be given the benefit of this reconsideration. There is no denial that the Mexican producers of zinc are getting the major benefit of the cut in tariff granted Canada. It has been a question, therefore, of how long the State Department could resist the demand that it invoke use of the escape clause.

The denial of this privilege has been based on a claimed belief in the State Department that zinc interests have not been hurt by the Canadian pact. High officials have unquestionably stated that belief. But numerous members of the Senate have not gracefully acceded to the conclusion. It is rumored late in April that the State Department is, therefore, to be forced into reopening the Canadian discussions. Officially there is no confirmation.

The reluctance of the State Department to take this action is based on the obvious embarrassment that may follow. A dozen other commodities have important political backing. They will all be on the Secretary's doorstep demanding comparable attention the morning after it becomes known that any commodity has been so favored. This simply illustrates the fact that tariffs are established by logrolling even when Congress does not act directly. No Secretary of State can fly in the face of a large number of the members of either House. And yet the escape clause has not at the date of writing been invoked.

Foreign Policy

THE FOREIGN POLICY decisions of Washington have three distinct, but somewhat interdependent, purposes other than political.

1. Outstanding first is the purpose of keeping the United States out of the European military conflict. But this effort, which is absolutely essential politically, is always tempered by the desire to maintain strong American influences favoring the democracies and the social movements for which America stands.

2. Second in importance is the effort made in the Orient to protect American business interest. This effort is now far more than for maintenance of the "open-door policy" in China. At the moment the focus of interest is the Netherlands Indies. (This subject is more fully elaborated from the standpoint of mining in related statements presented herein.)

3. Rather a poor third at present is the effort to develop the "Good Neighbor" policy for the Western Hemisphere. Intrinsically the most important of all, this effort is third merely because there are, comparatively speaking, no serious problems confronting Uncle Sam at the moment. The Mexican troubles of the mining industry, and the questions of Greenland and Iceland, though extremely important, are really small ripples on the international seas, hardly visible among tidal waves threatening major disaster to American institutions and policies.

Late in April it seems that the Administration has been able to work out a scheme for giving very generous support to the Allies without violation of the technicalities of American law, or stirring of undue protest from Germany. Even the attempted moral embargo which runs against Russia and Japan has caused little disturbance in diplomatic quarters. The recent protests of Japan and the earlier gestures by the Soviet are believed to have been largely for face-saving at home. Washington does not think that either of those two nations will or can do much about the matter.

The main uncertainty in the Capital is, therefore, as to what new commodities may be listed for embargo. It would not surprise some observers in Washington if copper and some other nonferrous metals and alloys were so withheld. But that restraint may not be necessary if the British blockade continues effective against movement of these materials from the Pacific States to Siberian ports. Specific embargo on movement of tin and other strategics to these countries may not be necessary, as export of those materials to *any* other nation is frowned on officially.

Strategic Survey

BUREAU OF MINES field studies will be continued during the next fiscal year for the exploration of possible deposits of strategic minerals. During the fiscal year which closes June 30 there were eight field parties working most of the time. A similar number of field groups will be organized for next year. It is hoped that somewhat smaller parties may be used, and that they may spend a shorter time at each field location.

During the past year new exploration technics had to be perfected and much new equipment purchased. That made the earlier work somewhat more expensive than was first planned. As a result the field work will be at a low level during May and June. The Bureau executives are much encouraged by the character of the field reports. In a number of cases they believe that they have identified metal occurrences of potential importance in case of extreme emergencies. However, they have not announced any results which indicate the prospect of new development commercially economic under normal conditions. They state, however, that "the new knowledge gained of the extent and character of reserves more than justifies the expense incurred."

The Economics Branch of the Bureau of Mines has now definitely established a routine for reporting monthly on domestic production, stocks, and use of the more important strategic materials. These reports will, it is hoped, give industry promptly a needed factual basis on which to plan imports, purchases, and future domestic operations of production.

More Trade Pacts

THE FOREIGN POLICY decisions of mined whether the President and Mr. Hull could secure a three-year extension of the authority to negotiate trade agreements was fought in the Senate. These Administration leaders won, by but a very thin margin. It is openly charged by spokesmen of business publications that the President had to "buy two Senators" in order to win this fight. The purchase price is said to have been "promised new patronage" which would insure re-election of these Administration allies.

The crucial vote in the Senate was so close that if two Senators had deserted the Administration, it would have lost its fight to prevent the requirement of Senate ratification of each new agreement. And that would have been practically as serious as a vote refusing to extend the authority at all.

It is not expected that Secretary Hull can open up any trade agreement discussions in the near future. Certainly no important European or other industrial country could afford at the moment to begin trading tariff cuts with us. And the Secretary has definitely promised, at least by implication, that he will not reopen discussion with Argentina or other important Latin American countries those questions which necessarily involve tariffs on agricultural products. It seems right, therefore, to conclude that in winning this legislative battle the President got an authority which can be used importantly only when European peace-making begins.

This question of European peace is frankly discussed about Washington even though few responsible observers now think that the war can possibly be ended in less than 12 to 24 months. Perhaps this latter belief is why there is so little criticism of the obvious Administration effort to formulate a basis on which Washington influence may become an important factor in the ultimate European settlements.

News "Fines"

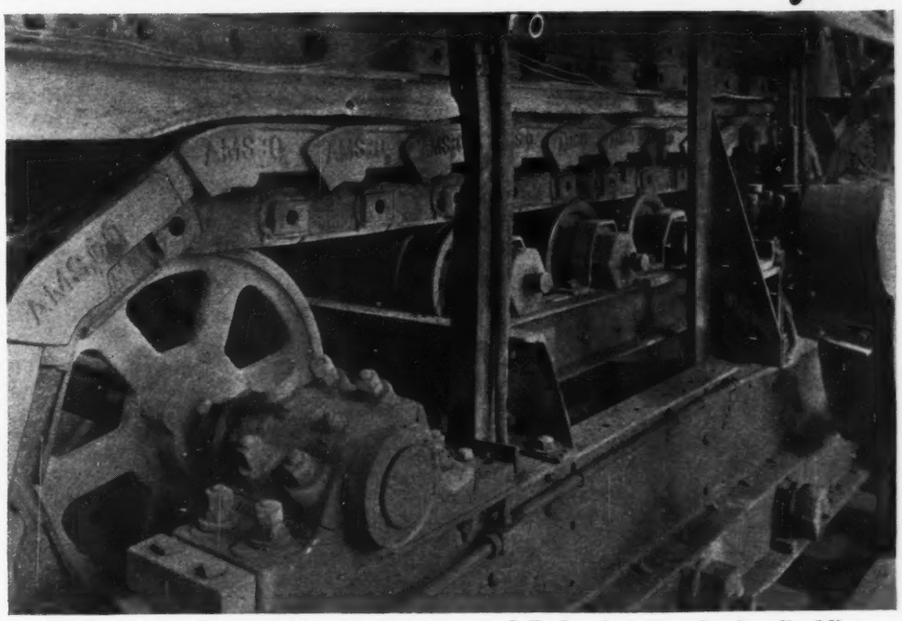
Strategics Buying—Plans for additional purchases of strategic materials for stockpile are being perfected. Immediately available is $3,000,000 of the $12,500,000 appropriated for next year. Last year's purchases appear to be resulting in satisfactory deliveries, with the possible exception of chromium from Alaska. Bids to be opened May 7 for chromium were the first of those taken for purchases with the new money.

On May 3 announcement was made by the Procurement Division of the Treasury Department of the following awards for the purchase of 2,104 tons of pig tin: Caswell, Strauss & Company, New York, 1,120 short tons at 46.93c. per pound; Wah Chang Trading Corporation, New York, 100 tons at 46.75c. per pound; C. S. Trench & Company, New York, 784 tons at 47.21c. per pound; American Metal Company Ltd., New York, 100 tons at 47.50c. per pound. This award is contingent upon the contractor furnishing tin smelted in this country from Bolivian ore. The ore to be supplied by other contractors listed above is of Oriental origin. Delivery must be made within six months. Bids for manganese ore, ferro-grade, will be opened on May 16.

Silver Buying—Decision regarding repeal of the Government's authority to buy foreign silver has been much delayed. Late in April it is difficult to say whether such unwelcome action will be taken by Congress. Many suspect that the threat of action is more intended to harass Administration officials than to change the law.

IT COSTS LESS *The S-A Way!*

MOVE THE EARTH FOR LESS PER TON



● *One of two Stephens-Adamson manganese steel Feeders in use at La Camelia Mine Mill of Cia Real Del Monte.*

14,200,000 TONS OF ORE IN 10 YEARS *and Still Going Strong*

Handling approximately 4,000 tons of ore daily, two S-A manganese steel Feeders in operation at La Camelia Mine Mill, part of Cia Real Del Monte's silver mine operations, have handled this tremendous total tonnage without showing appreciable wear—and without giving any trouble.

These two units are typical of the long life of Stephens-Adamson equipment — its ability to handle large tonnages over a long period *at the lowest possible cost per ton!*

Stephens-Adamson Belt Conveyors are each day building up similar records throughout the world.

The experience of the Stephens-Adamson organization, gained from 39 years of engineering and building all types of Material Handling equipment, prepares us to recommend reliable, up-to-the-minute methods of doing each job *most economically*.

In buying Material Handling equipment, IT'S THE COST PER TON OVER THE LIFE OF THE EQUIPMENT THAT COUNTS. Much of the success of Stephens-Adamson installations must be attributed to this basic thought behind the engineering and building of each job.

●

S-A PRODUCTS INCLUDE:

Bearing Units (SEALMASTER)
Belt Conveyors
Boat Loading and Unloading Equipment
Box Car Loaders
Bucket Elevators

Car Pullers
Crushers
Feeders
Gears, Sprockets, Pulleys
Grizzlies

Loading Booms
Pivoted Bucket Carriers
Portable Conveyors
REDLER Conveyor-Elevators
Screens

Skip Hoists
Speed Reducers (SACO)
Storage Controls
Transmission Equipment
Variable Speed Reducers (JFS)
Weighing Larries
Winches and Hoists

Catalogs sent upon request

Conveying • Elevating • Screening • Transmission Equipment

STEPHENS-ADAMSON MFG. CO.

4 RIDGEWAY AVENUE

LOS ANGELES, CAL. AURORA, ILLINOIS BELLEVILLE, ONTARIO.

IN THE FIRST PLACE
GREATER VENTILATION EFFICIENCY

AND ALSO IN THE FIRST PLACE
GREATER VENTILATION ECONOMY

BOTH PRIMARY FACTORS IN THE DESIGNING OF

JEFFREY
AERODYNE FANS

The Jeffrey Aerodyne (Patented) not only offers static efficiency upwards from 80% for the smallest size, thereby providing more *useful* ventilation per dollar spent for operation . . but costs less to *install* than other types of reversible centrifugal fans. While greater efficiency and economy are actually *two features* of the Aerodyne, they are but a single result of Jeffrey's improved design.

Jeffrey builds a complete line of mine ventilation equipment . . all reflecting its sixty odd years of experience in the coal and metal mining field. Let us show you how Jeffrey fans and blowers can give you better ventilation at less cost.

Write for free literature describing Jeffrey fans.

THE JEFFREY MANUFACTURING CO.
COLUMBUS OHIO, U. S. A.

NEVADA

Dayton Consolidated Mines Increasing Mill Capacity

Cyanide plant will be enlarged to treat 200 tons of ore per day — Deep drilling program planned at Richmond-Eureka lead-silver mines—Gray Rock Mining Company obtains larger power unit for pumping

▶ Excavation has started for additions to the 150-ton cyanide mill of the Dayton Consolidated Mines Company near Silver City. Added equipment will include two agitators, three thickeners, a duplex classifier, and new precipitation equipment, increasing mill capacity to 200 tons of gold ore per day. Homer L. Gibson is president and managing director.

▶ Because of its struggle with a persistent influx of warm water in excess of 5,000 g.p.m., which flow, mentioned in last year's report, has followed the shaft development downward, Gray Rock Mining Company, at Jarbridge, required additional capital to reach its objective at the 1,000-ft. level, according to the annual report of the Newmont Mining Corporation. Late in the year the corporation agreed to provide an additional $250,000 for this purpose as a senior loan, of which $85,000 is included in the item in 1939 development expenditures. The water situation has required substantial capital outlay to permit provision of additional electric energy, besides which standby diesel engines and generators to deliver 1,100 hp. have been installed at the shaft. However, diamond-drill holes from the 600 level have confirmed the belief that a valuable segment of the Long Hike vein underlies the present bottom of the shaft by some 300 ft. It is believed that substantially all necessary equipment has now been provided. Getchell Mine, Ind., in Nevada, mentioned in the last two reports of the Corporation, is managed by the organization of George Wingfield. The corporation at present owns 18.6 per cent of the issued shares. Published reports being unavailable, it may be stated that substantial progress has been made in development and equipment of this property, which is now treating 1,000 tons of ore per day. The 279,000 tons mined in 1939 carried an average of $7.66 gold per ton. Low mining costs, with power shovel, compensate for expensive metallurgy with rather low recovery, and the company paid dividends aggregating 38c. per share on its 1,500,000 issued capital in 1939. Developed tonnage already assures a long life at present scale of operation, and if its rate of increase during 1939 is maintained for another year, a somewhat larger rate of production will be indicated.

▶ Further efforts will be made, by deep diamond drilling, to locate extensions of the Richmond-Eureka lead-silver orebodies beyond the Ruby Hill fault. The properties are held under lease and option by the Eureka Corporation, Ltd., of Toronto, from the United States Smelting, Refining & Mining Company. Drilling will be conducted from the 800-ft. level of the 1,200-ft. five-compartment Locan shaft, lately reconditioned for this purpose and to explore upper levels. William Sharp is manager at Eureka.

▶ Property of the Gold Hill Development Company, four miles north of Round Mountain, in Nye county, purchased several years ago from Philadelphia men connected with leading Tonopah companies by the late Thomas F. Cole, has been sold to a syndicate composed of Nevada men, who will sink a new vertical shaft. Ben Morris and Fred Steigmeyer, of Round Mountain, head the new syndicate.

▶ After a month's interruption from storm-blocked roads, the Mountain City Copper Company is again trucking ore and concentrate to the rail point at Elko for shipment to the International smelter at Tooele, Utah. In the mine, extended lateral development is in progress on the 1,000-ft. level. During 1939 deliveries to the smelter were 21,385 dry tons of crude ore and 36,046 dry tons of concentrate, with net production of 27,988,176 lb. of copper and 6,457 oz. of silver. J. O. Elton of Salt Lake City is president and J. J. Lillie is manager.

▶ Gold-silver orebodies of promise are said to have been opened in the old Central district, in northern Pershing County, on property acquired under option by the lately organized Nevada-Keystone Mining Company, a subsidiary of the Silver Burro Exploration Company, which is said to be controlled by men affiliated with the Southwestern Engineering Company, of Los Angeles. Raymond Brooks, engineer is in charge and has headquarters at Winnemucca.

▶ A 50-ton mill will be provided at once to treat lessees' ore on a custom basis at the Copper Basin properties of the Copper Canyon Mining Company, according to a statement at Battle Mountain by L. E. Whicher, treasurer and executive head of the company, who recently visited the Lander County mines from his New York office.

▶ Completed several months ago with 500-ton rating, the cyanide mill of the Standard Cyaniding Company, in Pershing County, is treating upward of 600 tons per day, value of the ore having proved substantially higher than that indicated in development, which was around $2 gold per ton. Combined cost of mining and milling is 85c. per ton. Underground work has exposed wide ore sampling $10 to $15 per ton. H. L. Hazen is president and manager.

▶ Tonopah Belmont Development Company, in its annual report, states that on Oct. 31, 1939, less than an hour after the men left work, a heavy column of smoke was discovered coming up the Belmont shaft at Tonopah. A fire of unknown origin, underground, burned its way to the shaft and up the shaft to surface, where it destroyed the shops, ore bins, change room, and storehouse. In the mine, the stations, the shaft timbers, and the timbers in the Belmont vein stopes were completely burned. The volume of smoke and gas was so great that all parts of the mine had not been inspected up to March 1. Therefore definite plans for future operations have not been announced. A few leas-

ers have resumed work through neighboring shafts, in parts of the mine remote from the fire area. The Nevada Belmont mine and mill at Hamilton operated during the summer months of 1939. Several good shipments of lead concentrate were made, on which a profit was realized, although not enough to overcome the shutdown expense for the rest of the year. John L. Dynan is superintendent and Richard G. Park, Jr., is president.

NEW MEXICO

Chino Copper Company Improves Haulage System

Seven electric locomotives scheduled for use in 1940 in program of partial electrification of pit haulage—New smelter at Hurley operating satisfactorily

Copper production at the Chino property New Mexico, according to E. T. Stannard, president of Kennecott Copper Corporation, continued at a comparatively low rate for the first half of 1939, but was stepped up to full capacity during the last four months of the year. Orders for seven electric locomotives and other equipment necessary for the partial electrification of pit haulage were placed and preparatory track and line work was started towards the close of the year. At Hurley a dust-collecting system was installed in the primary crushing plant. At the power plant a new 10,000-kw. turbo generator and one high-pressure, high-superheat boiler were ordered and will be installed during 1940 to provide adequate generating capacity and permit more efficient utilization of reverberatory waste-heat steam. The new smelter, which embodies in its design the latest developments in smelting practice, has proved satisfactory in every way since placed in service early in May and has effected a material reduction in smelting costs.

Mineral Day at the New York World's Fair

MONDAY, June 17, has been designated Mineral Day at the New York World's Fair, sponsored by the Plainfield Mineralogical Society, New Jersey, and supported by a National Advisory Committee of eminent mineralogists. The purpose is to create interest in mineralogy and allied earth sciences. To this end special arrangements have been made to feature collections of minerals from the United States and foreign countries, and to display some unusual specimens such as the Jonker and Vargas diamonds. Mineral exhibits will be on display in the House of Jewels and in eight other buildings. A supplementary exhibit will be maintained during the period of the Fair at the R.C.A. building, Rockefeller Center, New York City. It is expected that Mineral Day at the Fair will afford laymen as well as professionals an unusual opportunity to acquaint themselves with the world's minerals.

A friend indeed WHEN YOU'RE "ON the ROCKS"

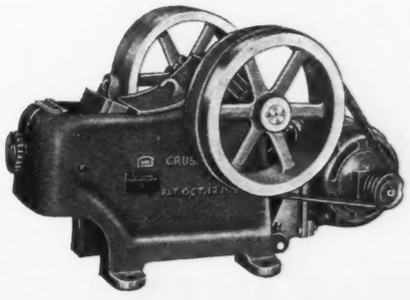
DFC LABORATORY CRUSHER

Are you spending too much time on the rocks ...working ore down to size for pulverizing? A host of Assayers have found this was the case... until they installed a DFC LABORATORY CRUSHER.

Investigate THE TIME, LABOR AND REPAIR SAVING FEATURES OF THIS MACHINE

1. Rugged one piece frame... no bolts to work loose.
2. Motor pivoted to frame... for correct belt tension & minimum bench space.
3. Easy to clean...no chance for salting.
4. Reversible jaw plates... double service.
5. Easy, positive adjustment for fineness.
6. Shielded, dust-proof working parts.

Available IN HAND OR POWER DRIVEN TYPES AND FOR FLAT OR V-BELT DRIVES



The DENVER FIRE CLAY Company

EL PASO, TEXAS · NEW YORK, N.Y. · DFC · SALT LAKE CITY, UTAH

DENVER, COLO., U.S.A.

MORE
crusher
FOR LESS
money!

● Now you can have that secondary crusher you need. Here's a genuine Telsmith — priced so low that you can't afford *not* to buy it—especially when the Intercone gives you such big capacity and steady production of ½ to ¾-in. rock at astonishingly low operating cost.

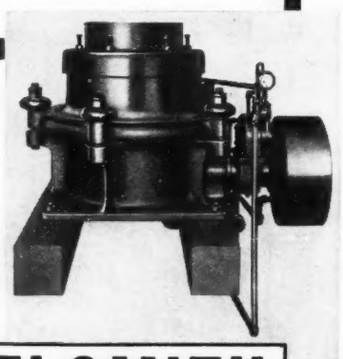
For years Telsmith has been designing and building crushers . . . of various types . . . each in some special way bettering crushing practice. Each has contributed some modern feature to the Intercone and the economy of its first cost.

THE ONLY LOW PRICE CRUSHER WITH THESE FEATURES

high speed • large capacity • wide range of fine sizes • strong steel structure • lead-bronze eccentric sleeves • manganese steel wearing surfaces • force-feed lubrication • protection against tramp iron.

Get Literature and Prices

SMITH ENGINEERING WORKS
502 E. Capitol Drive
Milwaukee Wisconsin



TELSMITH
INTERCONE
CRUSHER

Surface buildings near the Carlton tunnel in the Cripple Creek mining district, Colorado. The advance in this 9x8-ft. drainage tunnel from March 10 to April 9th totaled 1,881 ft. Longest daily advance to date is 74 ft. When completed, the tunnel will be 32,000 ft. long and will serve to drain many mines. Portal of tunnel can be seen to right of buildings shown on the left

COLORADO

Climax Molybdenum Plans Mine Air Conditioning

Installation of equipment to cost more than half million dollars now under way to improve mine ventilation—U. S. Vanadium Company completes plant for reclaiming uranium from tailings—Carlton Tunnel making rapid headway

▶ Climax Molybdenum Company has completed plans for installing air-conditioning equipment in the mine. Richard Murray, state mine inspector in this section of Colorado, after visiting the mine states: "A ventilation program for the entire Philipson tunnel level and the adjacent footwall area has been approved by the company and work started. Completion of this program will entail an expenditure of more than one half million dollars in drifts and raises, fans, mechanical doors, and other special equipment. When completed it will ventilate, under a controlled double airway system, all of the workings above the Philipson level, and as development work is carried on below the Philipson level, this double air-way system will be extended at the same time. Thousands of feet of headings and large intake and exhaust raises comprise some of the work entailed in the controlled air system. The fans will cost about $50,000."

▶ United States Vanadium Corporation recently completed the new $100,000 uranium concentrating plant at Uravan. This new 50-ton plant will reclaim uranium from tailings at the present vanadium mill. Carnotite ore, from which vanadium is taken, also contains uranium, and until this year no attempt to recover it has been made. Mr. Burwell is general manager and William G. Haldane general superintendent.

▶ The world's tunnel-driving records have been shattered a number of times at the Carlton drainage tunnel, at Cripple Creek. An advance of two miles in 209 days has been made by John Austin and his three crews of drillers. The average daily footage through April 3 was 50.53 ft. every 24 hours. The following week saw this record average beaten by 17 ft., as the drilling crew drove at the rate of 67.7 ft. daily—the longest being an advance of 74 ft. From March 10 to April 9, inclusive, the advance totaled 1,887 ft. The present burst of speed is said to be the result of changing to smaller bits, which have speeded drilling operations.

▶ The Superior Metal Mines, Inc., of Crested Butte, have been doing development work for the past three years on the old North Pole property. R. E. Simpson, president of the company plans diamond drilling to determine the extent of the orebodies. Six test cars of ore shipped to the Garfield, Utah, smelter showed a value of $20,000 in copper, silver, and gold.

▶ Smith-Bullard Mines Company, at Twin Lakes, has built a rail tram, 1,500 ft. long, from the mill site to the highway. The lower steel tower for the 3,700-ft. aërial tram has been erected, and as soon as the frost is out of the ground a concrete block anchor for the cable tram will be set, and the tram line completed. During the past winter the company built a compressor house and installed a compressor, and laid pipe for drifts and an 8-in. galvanized ventilation pipe with suction fans. Nearly two miles of road will be built connecting the other tunnel 1,200 ft. above the road just completed. Plans have been completed for a 100-ton mill. Dr. H. Bullard is president.

▶ The Black Jack gold, silver-lead mine, 1½ miles northwest of Ward, has been taken over by G. W. Jackson, who has erected a 15-ton mill. J. H. Porter is superintendent.

▶ Under the supervision of C. L. Harrington, of Idaho Springs, the creek diversion project of the Minnesota Mines at Empire will soon be completed. U. S. Seacrist has the contract to cut the new channel for Clear Creek, construct dams, and move the bridge. Some 25,000 cu. yd. of dirt must be moved in cutting

1,500 ft. of channel. When the dam is finished, the bridge will be put on rollers and shifted north over the new channel. Three dams, one being the diversion dam, will form two huge tailing disposal basins, estimated to hold ten years' supply of tailings. Mr. Clifford is general manager of Minnesota Mines.

▶ A good vein of gold ore in Specie Payment mine, on Seaton Mountain, Idaho Springs district, is reported developed by Parker and Hutchins, mining engineers of Denver.

▶ Charles Strong, Jr., and associates, operating the Bluecoat group of lead-silver mines at Jamestown, will soon be in production. Platinum and antimony are also reported found in these deposits.

▶ Q. B. Mining Company, lessee of the Black Belle Mine group, has been granted a government loan of $10,000 to develop the property. If successful in its operation, an additional loan of $20,000 is anticipated. Robert G. Park is president of the Black Belle Company.

▶ Golden Cache Mining Company, operating the Placer patented claim at Crisman, Boulder County, has started clearing away preparatory to putting in machinery to sink the Lost shaft.

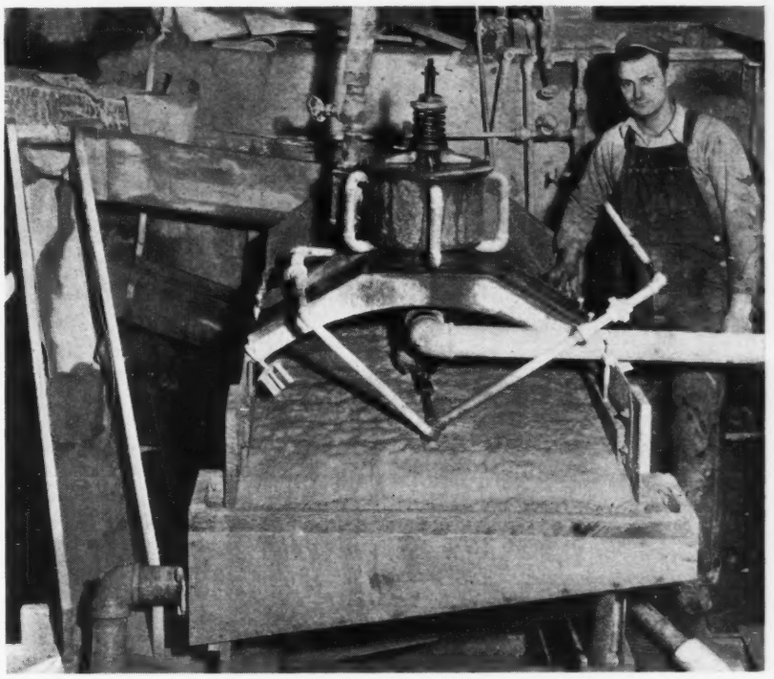
▶ On April 26, Philip B. Fleming, administrator of the Wage and Hour Division, United States Department of Labor, announced that open-cut mining of placer gold in Colorado is entitled to seasonal exemption. An application was filed by the Colorado Mining Association following, the granting of exemption for such work to Idaho, Montana, Nevada, Oregon, South Dakota, Utah, Washington, Wyoming, and the Territory of Alaska.

Explosives Used in 1939

THE Bureau of Mines has published figures on explosives manufactured and sold for domestic consumption in 1939. The total quantity of black blasting powder used was 2,329,473 kegs and cases of 25 lb. each. Of this amount, metal mines used only 8,050 kegs; coal mining, 2,046,740; quarries and non-metallic mines, 96,092; railway and construction work, 150,296; all other purposes, 28,295. Consumption for 1939 was 261,674 kegs or cases more than in 1938.

Consumption of high explosives amounted to 278,250,328 lb., of which 88,061,417 lb. was used in metal mines; 53,732,399 in non-metallic mines and quarries; 23,662,597 in coal mines; 99,706,525 in railway and construction work; and 13,087,390 for all other purposes. Total consumption for 1939 exceeded that for 1938 by 39,674,086 lb.

Railway and construction work accounted for the largest consumption of high explosives, other than "permissible," with metal mining second, quarrying and non-metallic mining third, and coal mining fourth. Coal mining used practically 88 per cent of the black blasting powder and 98 per cent of "permissible" explosives.



not *just another jig*

The Southwestern-Kraut Hydromotor Jig was built to render unusual service—to do special jobs that ordinary jigs can't do. As, for example, on the job illustrated above, in the 250 ton mill of a prominent California gold producer, where dilution in the mill circuit was already an acute problem and it was necessary to use a jig that would not aggravate this condition.

The SOUTHWESTERN-KRAUT

(DIAPHRAGM)

HYDROMOTOR JIG

makes this type of unusual performance possible because it embodies these exclusive features:

1. *Differential Stroke,* fast suction and lagging pulsion stroke.
2. *Variable Speed,* permitting ready control of the number of strokes per minute.
3. *Variable Stroke Length,* quickly and easily adjusted to meet individual requirements.
4. *Stroke Differential* and *Speed of Stroke* both are adjustable without interrupting operations.

Write for Illustrated Bulletin No. 300.

SOUTHWESTERN ENGINEERING CO.
4800 Santa Fe Avenue
Los Angeles, Calif.

BYRON JACKSON

SUBMERSIBLE

ANY DESIRED LENGTH

Flooded shafts or unexpected flows of water, which drown out conventional pumps, are no problem for a SUBMERSIBLE, with its motor direct-connected to the pumping unit and designed to run at all times completely submerged in water. The minimum overall dimensions of the SUBMERSIBLE make it ideal for shaft sinking, where space is at a premium—its efficient, trouble-free operation insures low operating costs.

A large, cross-section drawing printed in 4 colors clearly explains all details—write today for *your* copy—find out about the modern SUBMERSIBLE!

BYRON JACKSON CO.
Dept. MS-21
Box 2017 Terminal Annex
Los Angeles, California

IDAHO

Coeur d'Alene Mines Corp. Building New Mill

Results of development on lower levels sufficiently encouraging to proceed with construction of 300-ton plant — Sunshine Mining Company finds good ore on 3,100-ft. level

▶ Coeur d'Alene Mines Corporation, newest silver producer of the Coeur d'Alene district, has started construction of a new 300-ton flotation milling plant. The company is at present treating its ore at the Hercules mill in Wallace. The oreshoot on the 2,400 level of the mine has been proved for a length of 500 ft. and still going ahead. Stopes above this level are working on orebodies up to 20 ft. in width and averaging 30 oz. silver to the ton. Dr. H. C. Mowery is president and Daniel Leary is vice-president and manager of operations, Box 1068, Wallace, Idaho.

▶ An unexpected discovery of high-grade silver ore averaging 47 oz. per ton over a stope with of 5.3 ft. has been made on the 3,100 level of the Sunshine mine, according to R. D. Leisk, general manager. Ore reserves on April 1 were estimated to be 745,000 tons. For the first three months of 1940 the company mined 81,000 tons.

▶ Late in April diamond drilling revealed 2½ ft. of ore at the Sunshine Consolidated property on Big Creek on the 3,100-ft. level. The ore is the characteristic tetrahedrite of the silver belt.

▶ The shaft at the Morning mine of the Federal Mining & Smelting Company at Mullan will be lowered an additional 200 ft., from the 4,250 to the 4,450 level. This will open the Morning orebody 390 ft. below sea level, or 830 ft. short of a mile deep, making available for mining a portion of the 712,000 tons of ore estimated below present levels.

▶ The crosscut from the 1,500 ft. level of the Silver Summit mine, has advanced 250 ft., according to Harry P. Pearson, of Wallace, manager. Three shifts are making from 15 to 20 ft. daily.

▶ Golden Anchor Mining Company, operating in Idaho County, made a net profit of $184,796.15 during 1939. Cost of mining and milling operations for the year amounted to $154,309.45. The gold quartz property has a milling plant consisting of a 50-ton steam-driven Lane Chilean mill and cyanide plant. About 55 men are employed, with W. Buford Davis, manager. George Kingdon is president and J. W. Sievwright, secretary, both of Jerome, Ariz.

▶ Gregor Anderson, of Salmon, has sold the old Monolith gold mine, in the Shoup district, to R. L. Richmond and R. W. Allen. The property has a ten-stamp milling plant. A ball mill and classifier will be added by the new owners.

▶ Ima Mine, of Patterson, shipped a 30-ton carload of high grade tungsten ore to New York City the first of April. The company also shipped a 60-ton car of lead-silver concentrates to the Salt Lake smelter. W. P. Barton, of May, general manager, said sufficient ore has been developed for ten years' production at the present rate of 120 tons daily. About 75 men are employed.

▶ Silver Dollar Mining Company has shipped its first 20-ton lot of silver-copper concentrates to the Tacoma smelter from the recently leased Silver Crescent mill on Moon gulch. C. O. Dunlop, of Spokane, Wash., is president.

▶ A 50-ton custom milling plant will be erected in Salmon by Arline Davidson and associates.

▶ Ymir Consolidated Mines is reported to have opened a body of high-grade ore in the Carson district on War Eagle mountain. K. L. Stoker and H. R. Statham, of Pocatello, have shipped 100 tons of ore running from $175 to $350 per ton with values principally in gold. A mill is planned.

▶ The Constitution zinc mine, in the Pine Creek district near Kellogg, is reported to be planning a resumption of operations as soon as a new adit tunnel is completed. The property has been idle for a number of years.

▶ The mine and mill of the Hecla Mining Company operated on a five-day basis throughout 1939, according to Manager L. E. Hanley's annual report. Ore mined during the year totaled 240,407 tons, against 273,311 tons in 1938. The principal cause of the lower tonnage mined in 1939 is the reduction in operating days from six per week to five. The reduction took place on October 24, 1938, the effective date of the Wage-Hours Act. The rise of zinc production by the company is due to increased mining from the Ore-Or-No-Go vein, which contains more zinc per ton than do the Hecla veins, from which practically all ores have come in the past. Profits for the year were $578,034 after deducting all charges except taxes and depletion, compared with $718,715 in 1938. Ore reserves at the year's end are estimated at 548,898 tons. Taxes for 1939, covering property, income, and excise, amount to $140,279, or 24.27 per cent of the profits. The company employed, during the year, an average of 467 men, excluding salaried employees. Their average annual earnings were $1,604. The company's tax bill amounted to $300 per man employed, and to 40.08 per cent of the dividends paid.

▶ During the first nine months of 1939 operations in the Star mine of the Sullivan Mining Company were limited to keeping drifts and stopes in repair and a small amount of development on the 4,300 level. With the rise in the price of zinc and increased demand for the metal, stoping operations were resumed in October and full production was reached in December. Both mine and mill are being operated five days per week. The electrolytic zinc reduction plant of the Sullivan Mining Company was in continuous operation throughout the entire year at an average capacity of 49.7 per cent. Improved conditions resulted in an increase to 225 cells. On Oct. 1, 300 cells were placed in operation and on Dec. 1, for the first time, to the full capacity of the enlarged plant,

450 cells. There was produced during the year 18,426.79 tons of slab zinc and 85.24 tons of cadmium.

▶ The annual report of the Polaris Mining Company for 1939 states that development work on the 2,300 level, which corresponds in elevation with the 1,300 level of the Sunshine mine, was disappointing, but has not been completed. A crosscut toward the Chester vein was started and development of this vein will be prosecuted in 1940. Profits for the year, after deducting all charges except current taxes and depletion, totaled $202,920. Taxes for 1939, including property, income, and excise, amounted to $50,589. The company's tax levy is 24.93 per cent of its profits. Approximately one and one-fourth days' profits weekly are required to meet the tax levy. An average of 117 men, excluding salaried employees, were employed during the year. Their average annual earnings were $1,666. The total tax bill amounted to $432 per man. On March 21, 1940, directors of the company elected L. E. Hanley president and general manager to fill the position held by J. F. McCarthy, who died on March 6. James F. McCarthy, Jr., superintendent, was elected to the board of directors.

IRON COUNTRY

Ore Shipments Started Late in April

Operators anticipate an active season beginning with stocks of iron ore in good position

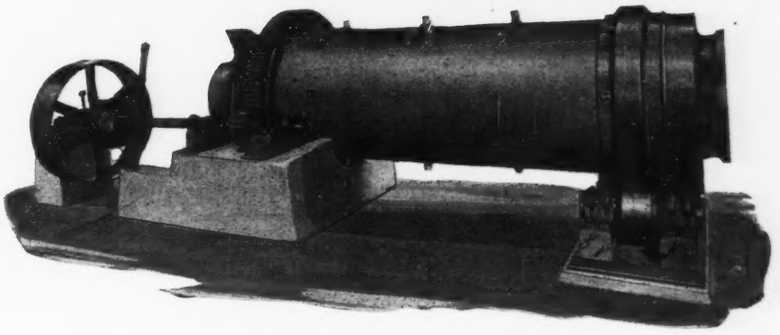
▶ Consumption of Lake Superior iron ore by furnaces during March was 4,087,767 tons. The remainder that was on hand at docks and furnace yards on April 1 was 21,862,302 tons. On May 1 the amount on hand was around 18,000,000 tons and this puts the iron ore industry in a good position to anticipate a busy season. Much activity is under way and all companies are loading ore from stockpiles or shafts. Ore shipments started on April 21 when the first ship departed from Escanaba, Mich.

▶ The independent mining companies have announced a price cut of 50c. per ton on iron ore for the 1940 season, and also the Lake freight price has been reduced 10c. per ton. It is not known definitely that the Oliver Iron Mining Company has made further sales of iron ore except that to the Ford Motor Company; and the independent operators hope that this policy may be changed, as it definitely affects all the independent companies and would have a serious effect on labor in the Minnesota mining country.

▶ A total of the various grades of iron ore shipped in 1939 follow:

U. S. Ranges	Tons
Non-Bessemer	34,361,388
Bessemer	8,232,070
Manganiferous	1,274,979
Siliceous	683,666
Total U. S. ranges	44,552,103
Canadian Bessemer	70,258
Grand total	44,622,361

More Accurate Regulation of the Grind is Possible with WEMCO ROD MILLS



Flexibility is a characteristic that we endeavor to build into all WEMCO products, and this is particularly evident in WEMCO Rod Mills.

Being provided with a variable level discharge, WEMCO Rod Mills are readily capable of meeting various grinding needs and consequently do not overgrind.

This is accomplished in a very simple manner by changing the area of the discharge opening, thus making it possible to more nearly obtain the grind desired.

Coarser grinds are possible with a minimum of slime and with a lower percentage of undersize to burden closed circuit operation. WEMCO Rod Mills are thus capable of delivering the finished product at reduced cost per ton of output.

All WEMCO Products are the result of careful designing and skillful engineering.

WESTERN MACHINERY COMPANY
FOR OVER 25 YEARS A SYMBOL OF SERVICE AND SAVINGS TO INDUSTRY

760 FOLSOM STREET **SAN FRANCISCO, CALIF.**

BRANCHES: SACRAMENTO, LOS ANGELES, PHOENIX, DENVER, SALT LAKE CITY, SPOKANE.

PAY FOR JIGS
OUT OF
ADDED
SAVINGS
IN 8 TO 14 MONTHS

This Dredge uses Pan-American Jigs.

Bucket-line dredges, dragline doodlebugs and dry-land washing plants—all are benefiting by the cost-saving efficiency of Pan-American Jigs.

Savings on riffle tailing losses alone are often sufficient to pay for your jig installation in 8 to 14 months.

Cost of operation is less than $.0006 per yard dredged.

Pan-American Jigs are tough and trouble-free. Large Placer Jigs for roughers. Small Pulsator Jigs for cleaners, or for roughers on small operations.

Write for Bulletins PLE and PJE.

PAN-AMERICAN ENGINEERING CO.
820 Parker St., Berkeley, Cal., U.S.A.

Design, Metallurgical Testing and Field Consulting Service; Manufacturers of Mill and Placer Recovery Equipment.

American Zinc Institute Looks at Industry Problems

Expanding outlets for zinc and improved technology offer encouragement despite disturbance of marketing and production policies caused by war abroad and politics at home

OFFERING a wide range of subjects dealing with the economics of the zinc industry, progress in the industrial uses of the metal, and new developments in technology, the American Zinc Institute presented an exceptionally good program at its twenty-second annual meeting in St. Louis on April 28–29.

In the spotlight was the reciprocal trade policy of the Government that resulted disastrously to the domestic zinc industry in the Canadian agreement. Walter R. Peabody, secretary, American Tariff League, discussed the subject at length, without, however, offering much hope for a modification of either the policy as a whole or the provisions of the Canadian agreement on zinc in particular. He felt that the zinc industry had good cause for complaint against tariff reduction, and that it had been well presented to the State Department and to Congress, but he was dubious about the prospect of getting any modification of the Canadian treaty that would restore the original tariff. No concessions thus far have been made by the State Department in response to protests against tariff reductions on other commodities, and he felt that zinc had little chance for consideration. On the ground that the whole policy is more important than any of its parts, the Government is not likely to reopen an agreement once it has been made. President Howard I. Young was more optimistic over the prospect and felt that the importance of the zinc industry in national defense would prove strong enough to persuade the State Department to rescind the Canadian agreement on zinc.

Foreign Zinc

The national legislative outlook in general was presented by R. S. Smethurst, associate counsel, National Association of Manufacturers. He emphasized the revolt in Congress against the arbitrary procedure adopted by several administrative bodies, notably the National Labor Relations Board and the Wage-Hour Administration, which has resulted in the current attempts to amend the Labor and Wage-Hour laws. The ultimate effectiveness of the revolt is uncertain, but it is indicative of a change of Congressional heart on the method of administration, if not on the policies, of the New Deal.

Influx of foreign zinc concentrate and its probable effect on the domestic industry was discussed by Joseph T. Hall, secretary of the Callahan Zinc-Lead Company. Mr. Hall gave a comprehensive world survey of zinc production, consumption, and smelting capacity, showing the relative position of the important groups of nations under present war-time conditions. The United States is in balance with respect to production and consumption but has a large unused smelting capacity that will probably be sought by foreign concentrate from nations lacking adequate smelting facilities. Under the present tariff this condition poses a problem to domestic producers, which will be intensified when the war is over unless the tariff situation is remedied.

A review of the domestic zinc market and world conditions affecting it was given by H. H. Wanders, market editor, *Engineering and Mining Journal.*

More Zinc in Automobiles

Amazing progress in the use of zinc alloy die castings during the past decade was reported by C. R. Maxon, of the New Jersey Zinc Company. The automotive industry is No. 1 consumer, using about 25 lb. per low-priced car and from 60 to 100 lb. in the larger and more luxurious cars. This compares with an average use of about 10 lb. per car in 1930. Numerous other industrial uses have been developed, until the consumption of zinc alloy die castings in 1939 amounted to over 16 per cent of the total zinc produced, compared with less than 5 per cent in 1930.

W. A. Janssen, chief of the Metals and Minerals Division of the Bureau of Foreign and Domestic Commerce, announced a new prospective service to the metal industries. The time of its inauguration has not yet been set, but it is projected as a voluntary commodity reporting program that will trace the flow of commodities from source to consumer. It will be especially useful to the domestic metal industries, in view of the curtailment of foreign markets by the war.

One entire session of the meeting was devoted to the Farm Market for Galvanized Metal Sheets, Tanks and Other Products. All speakers emphasized the importance of quality in meeting the increasingly exacting specifications of farm co-operative organizations. The farm market is highly important to the zinc industry and can be held only by meeting the demand for better service.

At the technical session, J. A. Singmaster reviewed progress in electrogalvanizing and outlined a new patented process of Hubbell and Weisberg for using zinc ore and byproducts directly with insoluble anodes. The zinc solvent is ammonia and ammonium salts instead of sulphuric acid as in the Tainton process, and high extractions are obtained from ordinary roasted ore, Waelz oxide, and zinc byproducts. Pilot-plant operations have produced electrogalvanized wire and more than one hundred tons of 10-in. strip steel.

Recent development in hot dip-galvanizing were reviewed by J. L. Schueler, of the Continental Steel Corporation,

showing progress made in methods of cleaning and fluxing ferrous objects prior to galvanizing in order to insure adherent coatings.

Elmer Isern, of the Eagle Picher Company, described and illustrated the differential density process of zinc-lead concentration in use at the company's central mill at Miami, Okla. This process has revolutionized concentration practice on Tri-State ores, resulting in coarser initial crushing, immediate removal of 60 per cent of the coarse feed as tailings, higher recovery of mineral, and 90 per cent increase in mill capacity. Finely ground galena suspended in water is used as the medium to separate mineral from gangue.

TRI-STATE

Work at Zinc Mines Continues Spotty

Some properties suspend operations as demand for concentrate declines — Jane E Mining Company purchases Tri-State holdings of the Vinegar Hill Zinc Company and Century Zinc Company

▶ There has been a noticeable slackening in demand for zinc concentrates during the past few weeks, but shipments have been only slightly under the production of 8,000 tons per week. Stocks in bins are less than the present weekly production, so the mine operators are still in a fairly strong statistical position. An average of fifty mills have been operating during the past month, including twelve tailings re-treatment mills and two treating a mixed feed of ore and tailings.

▶ F. S. Elfred, Jr., of Alton, Ill., announced the purchase of the operating holdings in the Tri-State district of the Vinegar Hill Zinc Company and the Century Zinc Company, to be effective as of April 8. The holdings of the Vinegar Hill Zinc Company include the famous Barr mine, which has been a consistent producer for over twenty years. The Century Zinc Company's holdings include the Scott mine, east of Hockerville, which has been operating more or less continuously since 1934. Both mills have a rated capacity of 50 tons per hour. The properties are being operated as the Jane E Mining Company.

▶ The Youngman Milling Company has suspended operations for an indefinite period at its tailing re-treatment mill just north of Picher, in Kansas. About 30 men were affected by the shutdown, according to H. D. Youngman.

▶ The Kropp mine and mill of the Davis-Big Chief Mining Company suspended in the middle of April, after a month's operation, throwing 40 men out of work. Surface churn drilling will be carried on during the shutdown, according to Claude Jones, president.

▶ The Cortez-King Brand Mines Company resumed operations at its New York tailings re-treatment mill the middle of April. The mill, which had been idle since Dec. 24, 1939, re-employed about 30 men, according to W. T. Landrum, district manager.

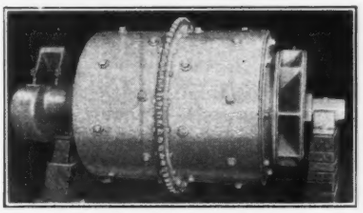
STRAUB *Truly Sectionalized* Equipment SOLVES TRANSPORTATION PROBLEMS

STRAUB crushing, grinding, and recovery equipment—as well as many kinds of auxiliary and power machinery—is available in either standard or sectionalized design. Write for Bulletin 302; complete data and specifications on the entire STRAUB line is included.

WHEN the job calls for transportation by plane, mule-back or ox-cart, the advantages of STRAUB Truly Sectionalized design pay handsome profits.

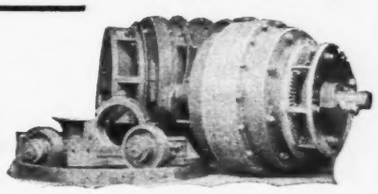
Complete STRAUB installations including crushers, Rib-Cone mills, feeders, amalgamation plates and tables, Diesel engine and auxiliary equipment are available in sectionalized design; photo at left shows part of such an installation en route "via air" to an Alaskan mine.

Below: A Rib-Cone Screening Mill, sectionalized design. Heaviest piece, 325 lbs!

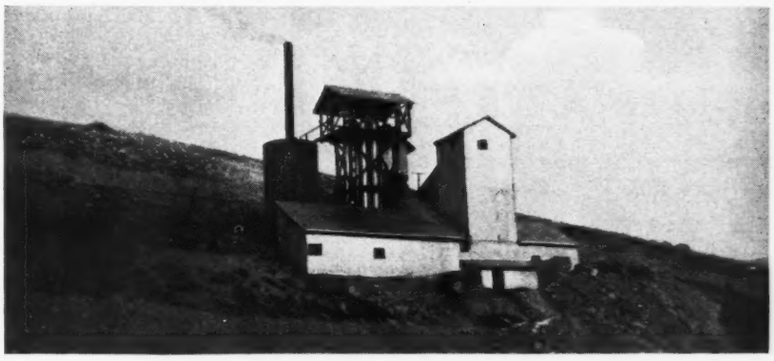


PIDANOS CATALOGO ESPANOL

"Anywhere a Mule can go!"



STRAUB MFG. CO.
567 Chestnut Street, Oakland, Calif.



Wild Horse Quicksilver Mining Co.—Churchill Co., Nevada

GOULD ROTARY FURNACE AND CONDENSING SYSTEM
From 5 to 200 Tons daily capacity
THE STANDARD OF QUICKSILVER REDUCTION EQUIPMENT

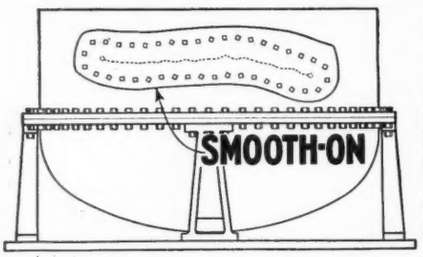
Each unit of any Gould plant is designed for, and built to, the demand of the job it has to perform. The Gould plant is not a stock job but one which is engineered for each application after individual characteristics of ore and operating conditions have been carefully studied. As operators of several of the largest quicksilver mines in the country, our plants are being constantly tested, improved on, checked and RE-CHECKED!

Let us help you with your plant requirements, let us design your plant—erect it if you wish, and provide a capable operator to get you started: let us provide you with a quicksilver plant which is recognized as standard the world over!

Lowest Costs
Accurate Control
Individually Designed
Greatest Flexibility

H. W. GOULD & CO.
MILLS BUILDING
SAN FRANCISCO, CAL.

Quick Repairs
How to make them



A crack in the shell casting or a leaking seam of a pressure container need not require disassembling the apparatus for a lengthy, costly repair or replacement.

With Smooth-On, the crack or leak can be speedily sealed *in place* and the repair will be permanently tight against steam, water, oil or gas.

By keeping a can of Smooth-On on hand, you will be prepared for such emergencies and many others such as loose parts of apparatus, fixtures, bolts, nuts, pipe connections, etc., which also can be permanently sealed by Smooth-On.

Buy Smooth-On No. 1 in 1-lb., 5-lb. can, or 25-lb., 100-lb. keg from your supply house or if necessary, from us. For your protection, insist on SMOOTH-ON—used by engineers and mechanics since 1895.

FREE

The Smooth-On Handbook — 40 pages — 170 diagrams — explaining time-saving, labor-saving and money-saving equipment repairs that every engineer and maintenance man should know about. Write today for your FREE copy.

SMOOTH-ON MFG. CO., Dept. 13
570 Communipaw Ave., Jersey City, N. J.

Please send SMOOTH-ON HANDBOOK.

Name .....

Address .....

.....

5-40.....

Do it with
SMOOTH-ON

MONTANA

New Large Hoist for Leonard Shaft

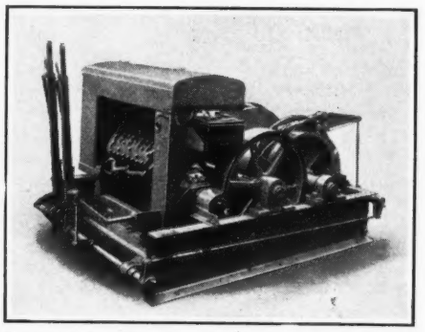
Anaconda Copper Mining Company prepares for deeper operations that require new hoisting and pumping equipment — Smelting will necessitate provision of new converters and casting division

▶ At the annual meeting of the stockholders of the Anaconda Copper Mining Company held recently at the office of the company at Anaconda, Cornelius F. Kelley, E. Roland Harriman, and Robert E. Dwyer were elected to serve as directors for the ensuing three years. Mr. Kelley stated that to take advantage of the low interest rates now prevailing, loans on five-year serial notes were negotiated whereby the company secured $35,000,000 at the rate of 1¾ per cent per annum. The funds thus provided will be used in calling on May 15, 1940, $33,000,000 of the $38,015,000 of the 4½ per cent sinking fund debentures of the company now outstanding. Through this transaction the annual interest charges will be reduced $907,500. The total reduction, including that of Chile Exploration Company ($229,000) in annual interest charges through these transactions, will amount to $1,136,500. The outstanding debt of the company and its subsidiaries will be reduced from $50,015,000 as of Dec. 31, 1939, to $43,815,000. Anaconda and its subsidiaries are in a sound cash position and after giving effect to these financial transactions will have on hand approximately $40,000,000, or $10,000,000 more than at the close of 1939. The first quarter earnings in 1940 amount to approximately $10,400,000, or about $1.20 per share. This compares with $3,687,000, or 42c. per share, for the first quarter of 1939.

Mr. Kelley also stated that exploration and development work on Butte Hill have been satisfactory and in large part were responsible for the authorization given late in April for the installation of a new electric hoist capable of hoisting from a depth of 5,000 ft. at the Leonard shaft. The lowest common drainage level at the mine is on the 2,800-ft. level. As most of the shafts in the west end of the property have reached a depth of 3,800 ft., a new drainage level is planned at this depth. This will necessitate the sinking of the High Ore shaft from the 3,400- to the 3,800-ft. level and the installation of modern pumping equipment at that point. Authorization was also given for the sinking and repairing of the Lexington shaft now bottomed at the 1,400-ft. level to the 2,800-ft. level. This work will serve to ventilate the mine workings on the State Vein and will afford the opportunity of developing large tonnages of zinc ore.

At Anaconda, authorization was given for a complete remodeling of the smelting department of the reduction works. Plans are now being completed for the relocation of the converting and casting divisions so that the total smelting operation will be more compact. This will

LOW COST HOISTING
with this
VULCAN-FORD V-8 MINE HOIST
ROPE PULL—2750 LBS.



Dependable, low-cost hoisting with 60 H. P. heavy duty, brand new Ford V8 Truck Engine. Outfit complete with governor, 17 plate battery, large capacity radiator, gasoline tank. Simple operation—no gears to shift. Drum 21" diameter by 18" face holding 1000 feet of ⅝" rope.

Write for details and prices

VULCAN IRON WORKS COMPANY
DENVER
COLORADO U.S.A. SINCE 1891

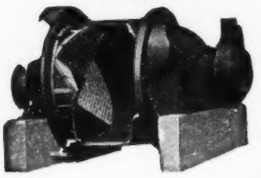
Manufacturers of Mine Hoists, Scraper Hoists, Mine Cages and Skips, Head Sheaves, Rope Rollers, etc.

YOUR GRINDING COST IS IMPORTANT TO YOU

Have you considered (1) it can be only as low as ball mill efficiency permits; (2) LOWER COSTS accompany higher ball mill efficiency.

The cost advantages distinguishing the performance of Williamson Mills, are the result of design which prevents slippage losses and increases the grinding capacity of the ball charge.

"It's the shape of the drum that does it"



Williamson Mills from 28" to 10½' in diameter are in use by leading mining companies the world over, and can give you that per ton economy in power, ball consumption and liner wear, that you want.

Let us help solve your cost cutting problems.

WILLIAMSON COMPANY
582 Market St. **San Francisco, Calif.**

result in the elimination of the expense of handling materials between the present reverberatory and converter divisions. The latest converting and casting equipment will be installed in the new converter and casting division.

MICHIGAN

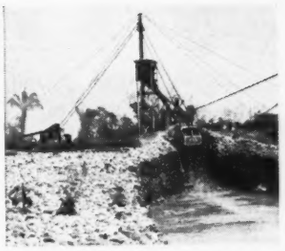
Deeper Mine Development Pursued by Copper Range

Diamond drilling coupled with geological studies of the Champion mine aids in determining development of copper-bearing areas in depth—Isle Royale Copper Company reports finding encouraging results in lower levels

▶ Production of copper during 1939 by the Copper Range Company, Painesdale, Mich., according to the annual report by W. H. Schaet, president, was slightly above that of 1938. Mining operations, however, just about broke even after making provision for general expense and depreciation. Social Security taxes and the Wage and Hour Law at present add nearly 0.5c. per pound to the cost of production. Mine production costs through the smelter, including current mine development and freight and selling expense, but before general expense and depreciation, for 1939 and preceding two years, were as follows:

Year	Production	Cost	Selling Price
1939	18,109,409 lb.	10.12¢	10.810¢
1938	18,010,937 lb.	9.50¢	9.800¢
1937	16,131,277 lb.	11.45¢	12.375¢

Operations below the 4,800 level in No. 4 shaft will be carried on with a subshaft equipped with an electrically operated hoist. All mining operations were confined to the Champion mine in 1939 and to the south end of the Globe property. The Globe mine is connected with the Champion mine on the 9th and 18th levels. Development work in the Champion mine on the lower levels continues to open ground carrying copper rock of satisfactory grade but within narrowing limits. Diamond drilling and development program coupled with geological study enable the engineers to project the intersection of mineral feeders with the lode in various parts of the mine. This has enabled the company to find minable areas in places heretofore unexplored, and this added to the minable ground opened up by delevopment on the lower levels has helped to maintain ore reserves, which latter are only about 10 per cent lower than on the first of January, 1939. It is expected that production from this territory in 1940 will show a substantial improvement over last year's output, which amounted to only 1,075,582 pounds of copper. The Champion mill, at Freda, was operated continuously throughout 1939 except for shutdowns for week-ends, holidays, and necessary repairs. The tonnage treated, which was shipped from the Champion and Globe mines exclusively, totaled 330,605 tons, with an average yield of 54.011 lbs. per ton, compared to 333,190 tons in 1938 with an average yield of 54.06 lbs. per ton. Encouraged by the improvement in the price of copper, operations at the tailings recovery plant



Small Sauerman Cableway digs and hauls 30 tons of alluvial gravel per hour at cost of 9¢ per ton. Larger Sauerman machines show costs as low as 3¢ per ton handled.

Sauerman Tower Excavator shown above offers large capacity in loading materials from pit or storage pile into cars or other conveyance.

SAUERMAN
Long Range
MACHINES

MOVE MATERIALS *At Lower Cost*

FOR larger profits on long range excavating and material handling work, use a Sauerman Drag Scraper, Slackline, or Tower Machine. A Sauerman machine is able to span an area 1000 ft. or more in width and convey materials from any point in this area at a rapid rate. One man handles the entire operation.

The sizes range from portable units for small pit operations up to huge machines with capacities approaching 1000 cu. yd. per hour.

In addition to the complete Sauerman machines, we offer also the various types of Sauerman buckets in sizes from ¼ cu. yd. to 15 cu. yd., "Durolite" Wire Rope Blocks (with either bronze bearings or roller bearings), Roller Bearing Two-Speed Scraper Hoists, etc.

"Durolite" Block with wide throat for knotted cables.

SAUERMAN BROS., INC.
484 S. Clinton St. Chicago

U.S. PAT. # 2125332
PATS PENDING IN OTHER COUNTRIES

HI-CASTE DIAMOND BITS

SET IN VANKOLITE, the perfect Bit-Metal

◆ **Achieve the lowest diamond cost per foot with HI-CASTE Diamond Bits. Set at *low temperature* by Smit's patented, exclusive method, the stones are protected against heat damage in setting.**

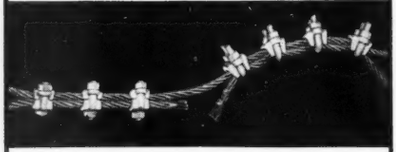
You can get HI-CASTE Diamond Bits in flat-faced and double-round-nose types. Also upon request, any other standard shape, size, wall thickness, or thread. Write for descriptive literature.

1. VANKOLITE is available only in Hi-Caste bits
2. Heat Injury to Diamonds eliminated through Patented Hi-Caste Setting method
3. Diamonds securely mounted
4. More and Smaller Diamonds
5. Sounder Diamonds at a lower price
6. More Cutting Points give Faster Drilling
7. Diamond Losses reduced by low pressure setting

J. K. SMIT & SONS, INC.
157 CHAMBERS STREET, NEW YORK CITY

THERE'S NO CRIMPING WITH THIS CLIP — IT GRIPS LIKE A FIST!

The Laughlin drop forged Safety Clip grabs wire rope with a grip like a fist—a vise-like, solid clench that *stays put*. When removed, it leaves the wire rope straight, uncrimped, ready to use again.



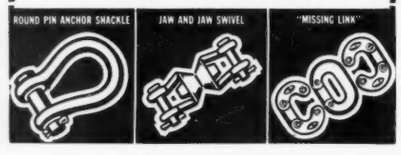
FOOLPROOF. Laughlin Safety Clips are easier and safer to apply. They can't be put on wrong. No fussing or waste of time. And three Laughlin Safety Clips will do the job of four ordinary U-Bolt Clips.

DOUBLED EFFICIENCY. Tests recently made by a leading engineering school prove Laughlin Safety Clips 50% more efficient than ordinary U-Bolt Clips.

FREE BULLETIN TELLS MONEY-SAVING FEATURES OF LAUGHLIN SAFETY CLIPS

These tests are described in a new booklet — which also gives other advantages to be gained by using Laughlin Safety Clips. Fill out the coupon below — and mail today. No obligation.

THE THOMAS LAUGHLIN CO.
Portland, Maine
Please send me free Safety Clip booklet E-4.
Name .....
Company .....
Address .....
Check here for catalog on items below ☐
Look for Laughlin products in "Metal and Non-Metallic Mining Catalogs" and buy through your distributor.



▶MICHIGAN

were resumed in September, but the plant was shut down again after a few weeks due to lack of dump hydro-electric power which makes the operation of this plant possible. This lack of dump power was due to a sub-normal rainfall and consequent shortage of water. It is hoped to resume operations in the spring. Mineral treated at the smelting plant totaled nearly 26,800 tons. This is an increase of about 16 per cent over the amount treated last year and is traceable to the increase in custom shipments to the smelter. This resulted in a slight reduction in the cost per ton of material treated and longer working periods for the employees. Experiments are now being made with an electric furnace for the production of steel balls and mill liners for some of the crushing and grinding equipment at the company's Champion mill, at Freda. In October the National Labor Relations Board ordered the local Mine, Mill, and Smelter Employees' organization disestablished, and the United Copper Workers' Union No. 494 of the International Union of Mine, Mill and Smelter Workers, CIO, won the elections held on Nov. 30 and Dec. 1. Following negotiations between the bargaining committee of the union and the company, an agreement which became effective Feb. 1, 1940, was entered into. The agreement provides that it shall remain in effect until Oct. 1, 1940, and that it shall continue thereafter from year to year unless terminated by 60 days' notice prior to the expiration date of any period. Increase in wage rates and other conditions will add to mining costs, the extent of which is difficult to determine at this time.

▶ The Isle Royale Copper Company made an operating profit of $74,409 for the year 1939. The past year concluded the first full year of mining operations since the shutdown in 1932. Production of refined copper was 8,094,888 lb., at an average cost sold and delivered of 9.95c., exclusive of depletion, depreciation, and amortization of mine reopening expense. The results are regarded as satisfactory. Better results are expected during the current year. The yield of copper per ton of rock treated was 21.135, or slightly over 1 per cent. The year's production included 28,978.36 oz. of silver. Development work was resumed in January of this year. Operations in 1939 consisted of stoping only.

Aluminum Co. Doubles Capacity in Washington

ALUMINUM COMPANY of America announced on April 16 that an additional contract for 32,500 kw. of power had been made with the Bonneville Power Administrator, and that the reduction plant now being built at Vancouver, Wash., would be doubled in capacity from 30,000,000 to 60,000,000 lb. aluminum per annum. Increase in aluminum production is to take care of heavy consumption in industry and the Government's preparedness program. The new contract for additional power is limited to five years, because the company cannot foresee how long the present heavy demand will continue. The original twenty-year contract for power was made last December.

CANADA

Cons. Min. & Smelting Investigates Zinc Process

Research department of company is determining merits of using oxygen in suspension roasting of zinc concentrates—Operations at Con and Box mines satisfactory—Quicksilver mine nears production in British Columbia

▶ In the annual report of Consolidated Mining & Smelting Company of Canada, Ltd., President S. G. Blaylock stated that in operations for 1939 costs per ton of ore mined of the Sullivan mine and concentrator were up slightly over those of last year, due chiefly to the lower tonnage mined, holiday payments, and a much higher silicosis assessment. The grade of ore mined was somewhat higher than in 1938. Plans have been made for diamond drilling this year below the 3,350 level. The underground crushing plant was completed and preparations were made for stope production from the lower levels. Pillar mining from within the surface fill has been started with satisfactory results and will be continued this year. Mill recoveries showed a considerable improvement over recent years and milling costs were approximately the same as in 1938. Despite the 10 per cent curtailment in lead production in common with other large lead producers, the tonnage smelted was an all-time record, due to smelting a charge of lower lead content. The adoption of a new type burner in the sintering division cut the oil consumption by 40 per cent.

Lead, silver, and gold refineries operated very successfully during the year, showing improvements in both costs and recoveries. Refined lead production was down, due to the 10 per cent curtailment, which ended on Sept. 15. Gold receipts at Trail in both bullion and high-grade ores were lower. Current efficiency was higher and acid loss lower than in 1938. The new electrolytic parting plant in the silver refinery went into operation on Dec. 18 and has given entire satisfaction.

At the zinc plant several new records were made. The outstanding achievement in this regard was in the roaster division, where an average of 121 tons was treated per roaster day, compared with 111 tons in 1938, and it is expected that this tonnage will be increased in 1940. An antimony reduction plant was built to work up an accumulation of antimony-arsenic flue dust. This plant is making an excellent product, but all the difficulties which developed in the process have not yet been overcome.

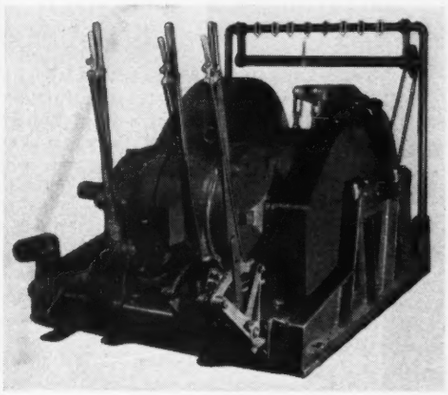
Technical progress was made in all divisions of the chemical and fertilizer plant. The percentage of sulphur dioxide removed from flue gases from metallur-

gical operations and utilized mainly in the production of sulphuric acid, sulphur, and fertilizers, increased to 70.3 per cent, compared with 62.4 per cent in 1938 and 53.3 per cent in 1937. The major construction items were additions to the sulphuric acid plant, construction of the underground crushing plant at the Sullivan mine, installation of a third sulphur reduction unit, and a cell-cooling system in one of the zinc tank rooms. The rebuilding of the silver refinery, the only piece of major construction unfinished at the end of the year, has been slow, due to the necessity of maintaining production in an area where reconstruction is taking place. The work should be completed by May, 1940. The principal investigations of the research department during 1939 included the use of oxygen in suspension roasting of zinc concentrates, which shows great promise, and the development of catalysts for sulphur reduction and ammonia synthesis. Development of an improved process on a semi-commercial scale for the production of magnesium was successfully concluded. A process for the production of manganese has been practically completed and production of oil from tar sands was intensively studied.

Operations in the Con mine, in the Yellowknife area, staked and owned by the company, on which a mill was built and put into operation more on the strength of the rich assays on the property than on the developed tonnages, have fully justified the confidence placed in this property. Although there was only about three months' ore developed when the mill started up, 53,000 tons have been mined and milled, in addition to which there was at the end of the year 53,720 tons of developed ore containing 0.86 oz. per ton in gold. The average grade of the ore mined to date has been 0.82 oz. gold per ton. It is estimated that early in 1940 the entire expenditure in connection with the Con will have been repaid out of profits. The tonnage developed and the prospects in the Yellowknife area justify the construction of a 4,700-hp. hydro-electric plant at Prosperous Lake. Application for the right to build this plant was granted in February, 1940, and a contract has been let for its construction.

Mine preparation in the Box mine, at Lake Athabaska, indicated that the grade of ore would be lower in value than that used in the earlier estimates made when construction of the power and mine plant was decided on. The subsequent diamond drilling campaign, together with previous information, indicated 2,328,000 tons of ore with a grade of 0.061 oz. of gold, an additional possible tonnage of 264,000 tons of 0.091 oz. besides a possible 10,000,000 to 15,000,000 tons of from 0.03 to 0.04 oz. of gold. Estimates of the cost of mining and milling indicated that sufficient profit could be made from this ore to justify the completion of the plants. These plants were completed and put in operation in July, 1939. Although the grade of the mill feed at first was below the estimate, each month showed a betterment and by the end of the year the estimated grade was reached and has been maintained since that date. The property made a small

HENDY "NEW SERIES"
MINE HOISTS
SINGLE and DOUBLE DRUM



In use throughout the United States and Foreign Countries.

REPEAT ORDERS SPEAK FOR THEMSELVES

Over thirty sold to one customer.

RIGID AND DURABLE
CONVENIENT TO OPERATE
COMPLY WITH SAFETY REGULATIONS.

COMPLETE MINE AND MILL EQUIPMENT.

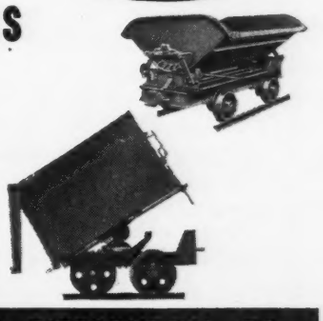
Bulletins on Request
Dept. E.

JOSHUA HENDY IRON WORKS
Address: Sales Office 206 Sansome St. San Francisco, California

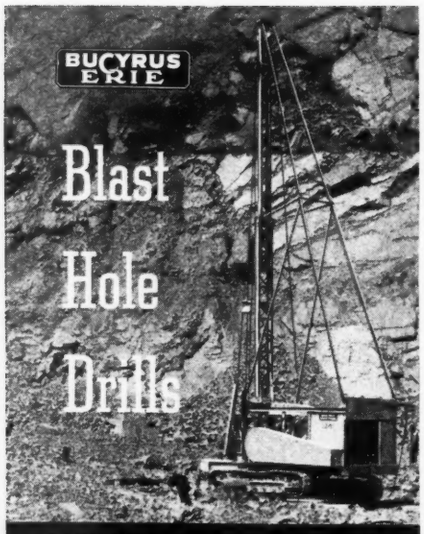
You get them all with
KOPPEL-BUILT QUARRY CARS

Built to the most rigid and exacting construction standards, Koppel Quarry Cars just naturally last longer and give more efficient service. With Koppel Quarry Cars, you get all the advantages of ruggedness, highest carrying capacity and quick, clean dumping action. High tensile steel construction is also available to those desiring low ratio of dead weight with maximum pay loads.

Write for your copy of our special Bulletin No. 71. Choose for yourself the car best suited to your requirements from the most complete and modern line of Industrial Cars in the world.



PRESSED STEEL CAR CO., INC. · PITTSBURGH, PA.
(KOPPEL DIVISION)



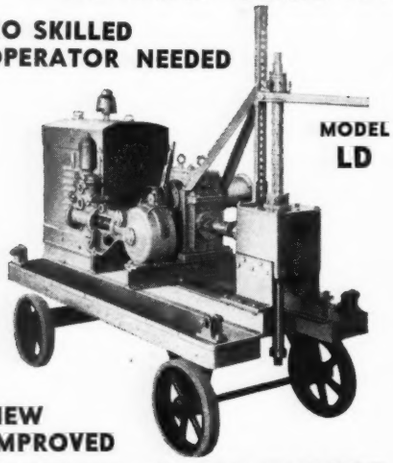
YOU WILL save money on blast hole drilling costs in your open pit mine with up-to-date, efficient Bucyrus-Erie blast hole drills. These drills — the 27-T, 29-T, and 42-T — are the hardest hitting drills you can buy . . they will drill larger holes faster than smaller holes were ever drilled before.

Write TODAY for complete information about the Bucyrus-Erie line of blast hole and prospecting drills.

BUCYRUS-ERIE
SOUTH MILWAUKEE, WIS.

PERFECT CORES AT LOW COST . . .

NO SKILLED OPERATOR NEEDED



NEW IMPROVED

ACKER CORE DRILL

• The portability and simplicity of this new compact outfit insure *rapid, deep drilling at lower cost.* Has all the time-tested features. Pressure instantly regulated to suit material. Mountable on skids, trucks or trailer. Drills to 600 feet. No special skill needed. Send handy coupon for complete data.

ACKER DRILL COMPANY
TOOL MFGRS. & DRILLING CONTRACTORS
SCRANTON, PA.

ACKER DRILL CO.
Gentlemen: Please send me full description and information on the NEW improved Acker Core Drill.

Name .....

Address .....

City and State .....

▶CANADA

profit in October, increasing steadily each month thereafter. Average total costs for the year, including the starting-up period, were $1.81 per ton, the best month's costs being $1.65. Metallurgical recoveries have been all that could be desired, the tailings for the year carrying only 0.0036 oz. gold. When sufficient tonnage has been extracted to make it definitely certain that the grade of the ore can be maintained, doubling the capacity of this mill may be undertaken to reduce costs still further.

An 85 per cent interest in a mercury property near Pinchi Lake, in British Columbia, was optioned and several more claims were staked by the company. As the property appeared to be promising, plans were rushed for bringing it into production as early as possible. A winter road was made and construction started. This plant should be in operation before midsummer. Concurrent development of the property is reported favorable and, in all probability, will call for doubling the plant as soon as the present 50-ton plant is in successful operation.

MEXICO

Mexican Miners Want Help If Silver Price Drops

Government is warned by delegates that the mining industry will suffer seriously and Federal protection would be necessary if silver declines to 20c.—Labor difficulties continue

▶Mid spring found considerable activity in the Mexican mining industry, some constructive, some inspired by apprehensions of the times in Mexico and abroad. Mining supplies some 54 per cent of the Mexican government's income and employs more than 80,000 men.

▶Tax phases of the mining industry, with a view to the possible reduction of some imposts, are being studied by the committee of Federal Government representatives and miners delegates that was proposed by the Ministry of Finance and approved by organized miners. The committee comprises Ing. David Segura, Ministry of National Economy; Ing. Agustin Rangel, Ministry of Finance, and Ing. Constantino Perez Duarte, for the miners. The Federal labor department is soon to appoint a representative on this committee, which, at the miners' request, is concentrating for the present on protective action in the event silver drops to 20c. an ounce. So marked a depreciation in the value of silver, the miners warned the government, will have most disadvantageous effects on mining in Mexico. Feasibility of slashing the 12 per cent on exports, income and excess profits taxes, in their application to mining, is also being considered by the committee.

▶A strike is looming for foreign companies in the Real del Monte belt, Hidalgo, if they refuse to grant demands

McGRAW-HILL DIRECT MAIL LISTS

AS business paper publishers for over 50 years, McGraw-Hill is uniquely equipped to offer complete, authoritative direct mail coverage of Industry's major markets. Extreme accuracy is maintained (guaranteed to 98%) and through careful analysis of markets, complete classification of companies and personnel, etc., the widest possible selections are available. Send for handy reference folder "Hundreds of Thousands of Reasons Why" which describes how McGraw-Hill Lists are built and maintained.

What Fields Do You Want to Reach?

Aviation Industry
Bus & Transit Industries
Business Executives
Chemical Process Industries
Civil Engineering & Construction
Coal Mining
Electrical Appliance Dealers
Electrical Contractors
Electrical Industry
Electrical Wholesalers
Food Industries
Manufacturing Industries
Metal Mining
Metal Working Industries
Mill Supply Distributors
Power Engineers
Product Engineers
Radio Dealers & Wholesalers
Radio Engineers
Textile Industries

For further details, selections from above basic classifications, counts, prices, etc., or estimates on special lists . . . ask any representative or write to

DIRECT MAIL DIVISION
McGRAW-HILL PUBLISHING CO.
330 W. 42nd STREET NEW YORK N. Y.

. . . Complete Lists Covering Industry's Major Markets

for new contracts that entail increased pay and other costly concessions. The national miners union has levied two pesos per month on each miner of these companies for an emergency strike fund.

▶ Cia. Minera de Penoles, S.A., has turned over to the workers its Bustillos mines, Bustillos, Chihuahua.

▶ Cia. Minera La Naica, S.A., La Naica, Chihuahua, has the prospect of becoming the property of its workers, as it has advised the federal labor department that operations are no longer profitable.

▶ The strike at Greene Cananea that started April 5 is still unsettled. The company has offered annual pay increase of 230,000 pesos, but workers demand 750,000 pesos, charging that company had a huge profit in 1939. The government has assigned accountants to inspect the company's books to determine if the charges are correct.

AFRICA

New Gold Mine for Orange Free State

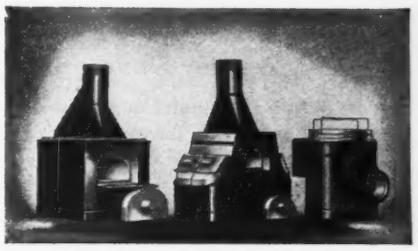
Decision virtually made to proceed with developing large area along Witwatersrand formation in that State under the direction of St. Helena Gold Mining Co.

▶ It evidently has been decided definitely to develop a producing mine on the Witwatersrand formation in the Orange Free State, as Western Holdings has made application to the Mining Leases Board for a lease of an area of 6,900 claims in the district of Ventersburg, extending the area already proved by diamond drilling. It is reported that the St. Helena Gold Mining Company will shortly be formed, and that the necessary working capital will be supplied by Western Holdings, South African Townships, Union Corporation, Selection Trust, Anglo American Corporation, African & European Investment, and Central Mining and Investment Corporation.

▶ The Southern Rhodesia government has raised the basic price which the producers get for their gold from 150 to 152s. per ounce, retroactive to Jan. 1.

▶ The position of the Rhodesian copper companies is indicated by statements which have been made by investment concerns largely interested in their shares. It was said at the meeting of Consolidated Mines Selection that since the outbreak of war the companies have "largely increased their production," to meet the requirements of the Ministry of Supply and that this copper is being sold at "satisfactory prices." British South Africa Company's chairman said the Northern Rhodesia copper production was largely increased after the outbreak of war and amounted to 210,923 long tons, or 9,500 tons more than the year before. He pointed out, however, that the excess war taxes are being levied on the difference between profits earned at a time when the companies had not reached capacity production and the profits on the greatly increased present output.

Good Furnaces Make Good Assays



Left to right—Braun Muffle Furnace, Combination Furnace and Bullion Melting Furnace

Nothing is of much more importance to the assayer than his means of using fire. That's why Braun Assay Furnaces have become the standard in assay offices the world over. They permit close regulation of the heat, assuring fast melting and perfect cupellation.

Braun Assay Furnaces include a complete selection of Muffle, Combination and Bullion Melting Furnaces. These furnaces are light in weight, ingenious in design and sturdy and durable in construction.

Braun Furnace Outfits are available with Gasoline, Oil, Gas or Cylinder Gas Burners. Install Braun Furnaces for complete satisfaction.

For detailed information write Dept. E-5 for Bulletin C-107

BRAUN CORPORATION

2260 EAST 15TH ST., LOS ANGELES, CALIF., U. S. A.

San Francisco, California
BRAUN-KNECHT-HEIMANN-CO.

BRAUN

Seattle, Washington
SCIENTIFIC SUPPLIES CO.

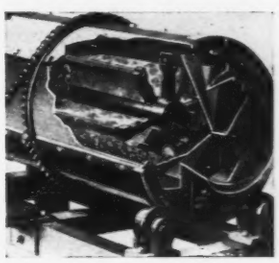
THE TITAN *Continuous* ROTARY AMALGAMATOR

May be easily and quickly installed in Your Recovery System

RECOVERS ALL THE FREE GOLD

As high as 98% recovery reported

Patented



MAINTENANCE COST VERY LOW

QUICK CLEAN-UP

Core can be removed, plates cleaned and replaced ready to run in 32 minutes or core can be withdrawn and replaced by spare core ready to run in 8 minutes.

MILL & MINE SUPPLY, INC.

MANUFACTURERS

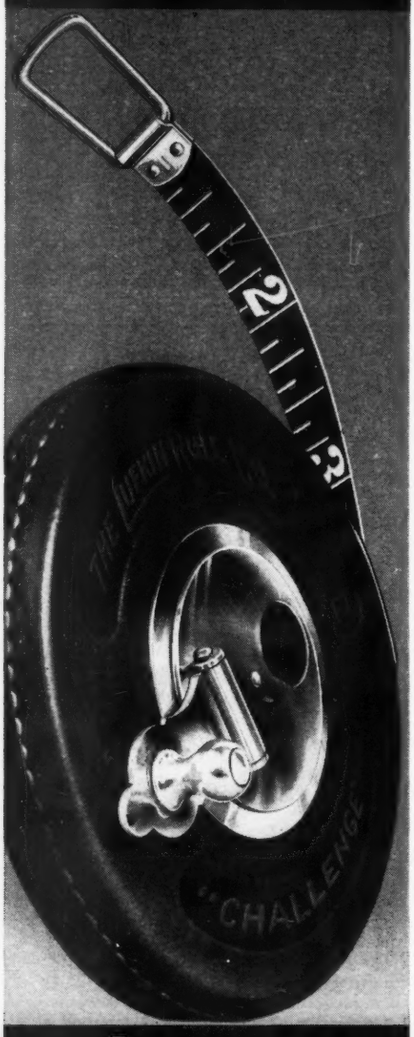
The best in Recovery Equipment

2700 Fourth Ave., So., Seattle, U.S.A. Cable Address MILLMINE

LUFKIN

"CHALLENGE" STEEL TAPES

If you want a tape you can depend upon for unfailing accuracy, one that is easy to read even after plenty of hard use, that is easy to handle and easy to carry, then you want a Lufkin "Challenge." See it at your dealers or write for free complete catalog.



LUFKIN

SAGINAW, MICHIGAN • New York City

TAPES . RULES . PRECISION TOOLS

AUSTRALIA

Copper Mines Planning Greater Development

Need for the metal in the country brings higher prices, thereby encouraging exploitation of several additional deposits—Government aids gold miners

▶ Domestic prices for the principal nonferrous metals were increased in March and are now as follows:

Per long ton of 2,240 lb. Australian Currency

	New Price	Previous
Lead	£22	£20–17–3
Zinc	£22	£20– 2–6
Tin	£306	£299
Copper	£76	£63–17–6

▶ The new prices are still below the Australian currency equivalent of the English maximum prices. Those of lead and zinc will, it is expected, remain unchanged for the duration of the war unless there are marked rises in the cost of production. The price of copper has been raised proportionately more than the others, principally because there is a marked shortage of the metal in Australia and it is hoped that the increase will bring out a substantially increased production. There are many deposits in Australia, particularly in Queensland, which have been unworkable at the previous range of prices, but which may now prove economic to exploit. The two principal copper producers, Mount Lyell and Mount Morgan, have agreed to use the increase in price above £A72 further to develop and extend their undertakings.

Victoria

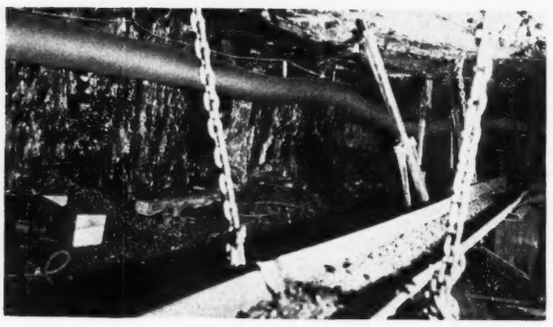
▶ Gold production at 156,522 oz. for 1939 was the highest since 1917. There is every indication that the 1940 production will set up a new record. A progressive policy is followed by the Government in respect of assistance to those in the industry, which has stimulated production of gold. Among the grants made during 1939 was £A10,117 to assist companies, syndicates, and parties under the joint State and Commonwealth scheme; grants to 333 parties, comprising 738 men, by way of advances from unemployment relief funds; and provision of prospecting equipment, made last year to 714 men.

▶ Another promising development has occurred on the Bendigo field, where a gold-bearing formation is being opened up on the 1130-ft. level of the Hercules mine.

Fiji Island

▶ Gold output of Fiji during 1939 is estimated at 110,000 oz., which compares with 89,354 oz. in 1938 and 21,407 oz. in 1937. With the expected treatment of higher-grade ore at the Emperor and developments in other directions, 1940 should show another substantial lift. The flotation plant at the Emperor mine is nearing completion and should be in operation in May.

AUXILIARY VENTILATION



If you have working places that are clouded by powder fumes, gases, and dust, give MINE VENT a chance to carry a constant supply of fresh air up to them.

Use the tubing that will best suit your conditions by choosing one of MINE VENT's four grades of tubing.

No matter what your conditions may be, MINE VENT will furnish inexpensive, dependable, ventilation for you . . . Rapidly installed by use of the newly developed demountable split coupling.

For Service and Satisfaction Use

MineVent TRADE MARK FLEXIBLE

AMERICAN BRATTICE CLOTH CORP.
WARSAW, INDIANA

NEW BOOKS

METAL MINING PRACTICE. *By Charles F. Jackson and J. H. Hedges. Bulletin 419, United States Bureau of Mines. Pp. 512. Sold by Superintendent of Documents, Washington, D. C. Price 60c.*

THE GREAT SERVICE rendered to the mining industry by the Bureau of Mines in the last twelve years in producing its long series of information circulars on mining methods and on operation in general at selected, individual properties has been pointed out more than once in these columns (and this series was supplemented by a shorter list of papers on milling methods). From the beginning of this ambitious project to its end, if it be ended, this work was under the direct supervision of Charles F. Jackson, chief engineer of the Bureau's Mining Division, who also prepared several of the papers himself. Those who have saved, or collected, these papers have a veritable library of mining practice by now. The first circular appeared in December, 1928, and by Dec. 31, 1938, the total number dealing with mining and milling of metallic ores was 250. Of this number, 164 deal with operations at individual mines and plants. Eleven circulars are summaries, each covering a particular mining method, and 53 are discussions of separate operations involved in mining or deal with special phases of mining.

Useful as it is, this collection nevertheless calls for considerable digging by a person seeking a broad view of any particular detail or phase of operation as conducted in a large number of enterprises. This difficulty has been partly removed by the several summaries already published, and is now reduced to the vanishing point by the new bulletin, No. 419, of which Mr. Jackson is senior author. This bulletin consolidates and analyses the information contained in the earlier reports on methods, practices, and costs.

Bulletin 419, in reality, is a textbook of metal-mining practice and a very practical one. The price of 60c. should not be allowed to deceive any one as to its value. It is arranged after the manner of a textbook. It starts with definitions, then takes up the various phases of mining practice, beginning with prospecting, exploration, sampling, and estimation of reserves, next passing to development, transportation, stoping practices, and direct costs. Following this, 60 pages are devoted to surface mining practice. The authors then have included 65 pages on ore dressing (of gold, copper, and lead-zinc ores), dealt with from the economic viewpoint rather than the technologic. Results obtained are stressed rather than process details. The book concludes with twenty pages on the total cost of producing ore and concentrates, realization from their sale (including sale of bullion), and the engineering valuation of mining properties. A valuable feature is that the volume is well indexed.

A. H. HUBBELL

MINING YEAR BOOK, 1940. *Walter E. Skinner, 15 Dowgate Hill, Cannon St., London, E. C. 4, England. Price 20s. net; 21s. 6d. post free abroad.*

NEARLY 1,000 pages in this 54th annual edition of the Mining Year Book are required to give details of importance about the operations of 1,140 mining companies. African, Australasian, Canadian, and American companies are covered in the usual thorough manner. Appendices give lists of directors, mining engineers, and mine managers, with their addresses and the companies with which they are associated. A useful feature is nineteen sketch maps of the properties of important mining companies.

DISCOVERY OF THE ELEMENTS. *By Mary Elvira Weeks, associate professor of chemistry at the University of Kansas; with illustrations reprinted from a collection by F. B. Dains, professor of chemistry at the University of Kansas. Published by the Journal of Chemical Education, Easton, Pa., 1939; fourth revised edition. Pp. 462. Price $3.*

PRESENTING the record suggested by the title, chronologically and with adequate annotations. The work treats the historical review entertainingly and lucidly, and the fine collection of prints which Professor Dains has made available will delight the student and those, also, whose libraries contain a section devoted to works on the elements, chemistry, and related subjects.

CONTRIBUTION A L'ÉTUDE DES MINES MÉTALLIQUES. *By Michel Castelain. Dunod, Paris, 1939. Bound in paper. Pp. 205. Price 35 francs.*

THIS is No. 48 of a series of "notes et mémoires" of the mining and geological survey of French Morocco. Written by the "Chef des Bureaux Techniques" of the Bureau of Mines of Morocco and privately printed, apparently under a subsidy of the Ministry of Public Works of Morocco, it forms the second of a pair of texts of which the first dealt with coal and iron mining in Morocco under the title of "Technologie Minière—Cours pratique d'exploitation des Mines et des Carrières." The two together might be described as a textbook, or handbook, of mining as practiced in that French colony. It is divided into three parts: a brief one on methods of exploration and development, a much longer one on methods of mining, and a third on gravity concentration, flotation, and the calcination of calamine. An appended advertisement of the preceding work indicates that some accessory matters, such as air-compression, ventilation, and underground transportation, were so thoroughly covered in it that they are given briefer treatment here.

A striking feature of the text is its 142 illustrations, mostly well-executed line drawings of methods, equipment, or geological structures, with a few mediocre photographs. The major interest in the work for an American attaches to its map (on a scale of 1 to 4,000,000, or about 60 miles to the inch) of mineral deposits in French Morocco, the list of operating companies, the detailed geological sketches and maps of individual deposits, and the list of publications of the mining and geological survey. Of minor interest is the frequent appearance of the words American and Yankee in connection with methods or equipment.

T. T. READ

PROCEDURE HANDBOOK OF ARC WELDING DESIGN AND PRACTICE. *Lincoln Electric Company, Cleveland, O. Pp. 1125. Illustrations 1557. Price: U.S.A. $1.50; elsewhere $2.*

IN THIS, the sixth edition of the handbook, the publisher has produced an encyclopedic reference work on arc welding. It includes new data collected by a staff of 200 engineers who have been in touch with all kinds of industries throughout the world. Eight chapters deal with welding methods and equipment; technique of welding; procedures, speeds, and costs; weld metal and methods of testing; weldability of metals; welded steel construction—machine design; designing of arc-welded structures; and typical applications of arc welding in manufacturing, construction, and maintenance. The last chapter—application—consists of 270 pages of photographic illustrations of the use of arc welding in industry. The mining industry will find special interest in sections devoted to maintenance, materials-handling equipment, mining equipment, and rock-products plants.

▼ ▼ ▼

PUBLICATIONS

RECEIVED

The Determiation of Tellurium in Tin-rich Alloys. By W. T. Pell-Walpole. Pp. 3. Publication No. 96 of the International Tin Research and Development Council, Fraser Road, Greenford, Middlesex, England.

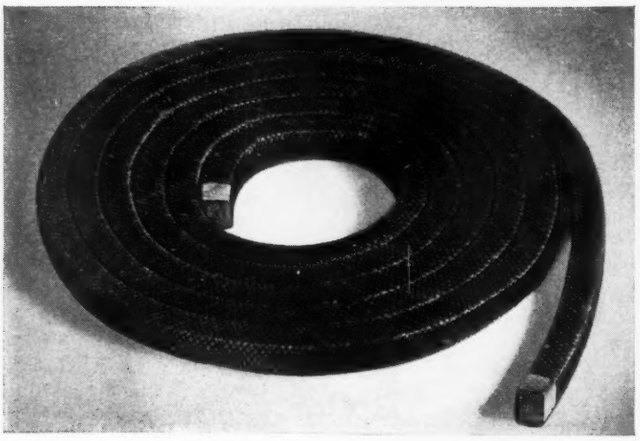
Uses and Applications of Sheet and Waste Mica. By Ramani Ranjan Chowdhury. Bulletin 3 of the Geological, Mining and Metallurgical Society of India, Presidency College, Calcutta. Pp. 20. Price 2 rupees.

Gold Coast Colony. Report of the Mines Department for 1938–39. Government Printing Department, Accra, Gold Coast Colony. Pp. 29. Price 2s.

Gold Placers of the Secesh Basin, Idaho County, Idaho. By S. R. Capps. Pamphlet 52, Idaho Bureau of Mines and Geology, Moscow, Idaho. Pp. 43. Price 50c.

The Rockefeller Foundation. A Review for 1939. By Raymond B. Fosdick, president. Pp. 72. New York.

Analyses, Lake Superior Iron Ores, Season 1939. Published by Lake Superior Iron Ore Association, 1170 Hanna Building, Cleveland, Ohio. Pp. 26.



Garlock 926 Plastallic—for water, steam or air up to 550°F. Loose or bulk form, coil and ring.

Garlock 927 Plastallic—for gasoline, oils, ether, etc., up to 550°F. Loose or bulk form, coil and ring.

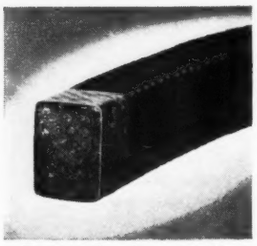
Garlock 928 Plastallic—for steam and hot oils over 550°F Loose or bulk form, coil and ring.

Garlock 929 Plastallic—for water, steam and general service up to 550°F. Loose or bulk form, coil and ring.

Garlock 930 Plastallic—for gasoline, oils, gases, etc., at high or low temperatures. Coil, spiral and ring form.

Garlock 931 Plastallic—for steam, water or air at high or low temperatures. Coil and ring form.

Garlock 924 Plastallic—for acids and strong chemical solutions. Loose or bulk form, coil and ring.



Rectangular Cross Section

You'll Like THIS Plastic Packing!

For every service where a plastic packing is desired —use GARLOCK *Plastallic*. These superior plastic packings are scientifically compounded to GARLOCK formulae. Only the purest asbestos fibre, soft metals, graphite and special lubricants enter into their construction.

GARLOCK *Plastallic* is easy to apply; in service it combines into one homogeneous mass. Our new rectangular or out-of-square coil *Plastallic* packings fit two different sized packing spaces, as they may be applied with either the long or short dimension parallel to the rod. Write for descriptive folder!

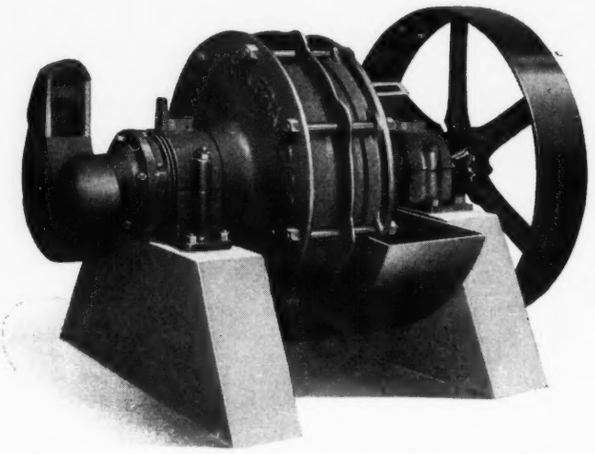
THE GARLOCK PACKING CO.
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

GARLOCK *Plastallic*

IMPROVED GIBSON POCKET HUNTER

Gives High Recoveries at Low Cost



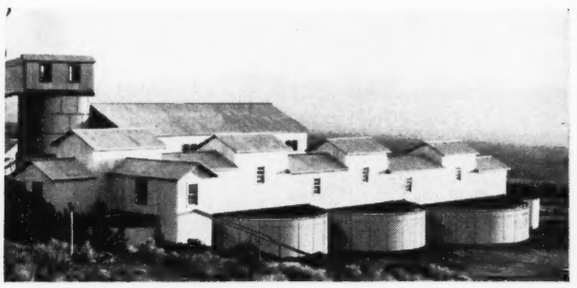
FOR economical extraction of ore, the Gibson Pocket Hunter that will crush 2-in. material, grind and amalgamate in one pass, has proved to be extremely popular with small prospectors. Now its operating economy has been further improved by steel bearings, lined with bronze. Other wearing parts constructed of manganese steel and the balance of heat-treated chrome nickel steel. The mill is sturdily built, guaranteed unbreakable, and easily transported as weight of heaviest part is only 85 lbs.

Price of mill rated at 2 ton capacity with 1½ hp. engine and belting $290.00. Price without power $225.00. Also built in 5, 10, 12, 25, 50 and 100 ton capacities.

Write for new catalogue describing Gibson Counter Balanced Rod and Ball Mills, Prospectors' Friend Mills, Flotation Cells, Amalgamators, Concentrators, Rock Breakers, Ore Feeders, Mercury Feeders, Oil Feeders and Retorts.

W. W. GIBSON

1801 WEBSTER ST.
ALAMEDA, CALIFORNIA



DIVIDENDS for Years to Come!

Be sure your investment in mining equipment pays dividends for years to come! Buy COLUMBIAN BOLTED STEEL MINING EQUIPMENT which has proved in actual service to be outstanding for endurance and trouble-free service!

COLUMBIAN Bolted Steel MINING EQUIPMENT

Agitators, thickeners, ore bins, solution tanks, etc., which give you a double service advantage—(1) they are for permanent installation, (2) are portable if change is necessary! Standard construction for domestic use and for export via ocean freight. Special if for export via mule-back or aeroplane to final destination. Order from our distributors listed below—or write direct for further information.

COLUMBIAN STEEL TANK CO.
P. O. Box 4226-H **KANSAS CITY, MO.**

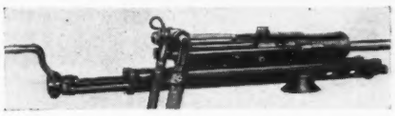
Distributors

DENVER EQUIPMENT CO., 1413—19 Seventeenth St., Denver, Colorado
EIMCO CORPORATION, 634 South Fourth West Street, Salt Lake City, Utah
HARDINGE COMPANY, York, Pa.

EQUIPMENT NEWS

New Drifter for One-Man Operation

DESCRIBED as a true one-man drifting drill, a new, light 2¾-in. drifter, known as the D–73, is announced by the Gardner-Denver Company, Quincy, Ill. This new machine weighs 118 lb., and according to the manufacturer, has unusual ability to rotate in tight or fitchery ground. In actual operation, the drill

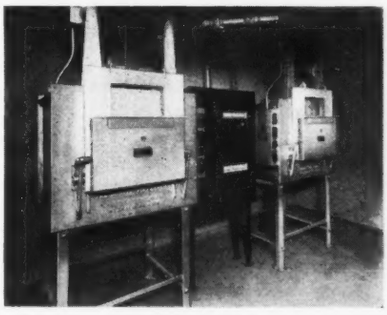


is reported to have shown itself well suited for use in moderate ground, in small headings, and also in remote working places and in locations difficult of access with heavier drills. The D–73 drifter is said, according to field tests, to be the equal of most 3-in. drifters in drilling speed and power of rotation. At the same time, its air consumption is said to be lower in proportion to its smaller bore. Gardner-Denver executives explain that the modern high performance of the Gardner-Denver "H" valve is incorporated in this drill, permitting unrestricted admission of air with an extremely short valve stroke. Powerful four-pawl rotation is claimed, as the pawls are reversible for double wear. This new drifter has the mounting ways integral with the cylinder. It is made in three types of chuck construction—lug shank steel, 1-in. to 1¼-in. round-collared steel, ⅞-in. or 1-in. hexagon or quarter octagon; and tappet construction for straight shank steel, hexagon, or quarter octagon. Other construction features include: drop-forged cylinder with a bushing having a renewable bronze line; ¾-in. side rods of special stock with long cap nuts to protect the threads, a large central chuck driver flange which absorbs and thrust; large oil reservoir surrounding the cylinder bushing that feeds oil automatically to all working parts of the drill; and guide shell mountings in either the solid cone or sliding cone style available.

Electric Assay Furnace

A NEW LINE consisting of four models of electrically heated assay furnaces employing nickel-chromium elements and featuring automatic temperature control and electric door operation and ventilation is announced by Denver Fire Clay Company, Denver, Colo.

Heating elements are U-shaped bars of nickel-chromium, so bent and mounted

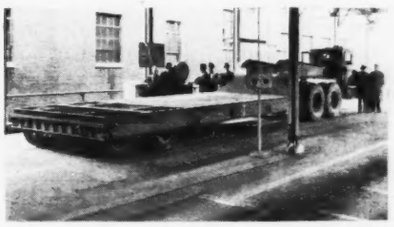


in the multiple-block refractory lining that one edge and two sides of each bar are presented to the heating chamber instead of the customary one side only. The grooves housing these bars are parabolic in shape. Construction and special mountings are said to increase the effective radiating surface of the heating elements 41 per cent. Operating at 22 Kw., fusing heat of 1,850 deg. F. is said to be reached in two hours and is readily maintained with 15- to 18-Kw. consumption. Cupeling heat is maintained with 12 to 15 Kw.

Capacity for all the models is the same: Thirty-five 20-gram or twenty-four 30-gram crucibles can be used. Advantages given by the manufacturer are (1) absolute and constant control of temperatures; (2) positive control of atmospheric conditions; (3) clean, noiseless, and no gases of combustion produced requiring disposal; and (4) economical if current is available around 1½c. per kilowatt or less.

Motor Truck Scales

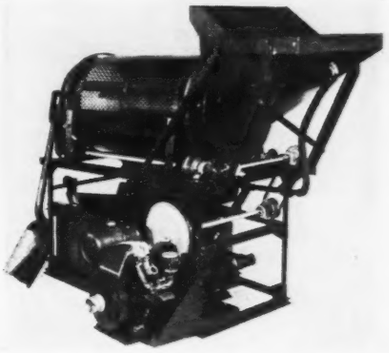
THREE COMPLETE LINES of motor-truck scales, comprising 128 different styles with weighing capacities up to 70,000 lb., are announced by the Toledo



Scale Company, Toledo, Ohio, for 1940. Although motor-truck scales have been manufactured by this company for many years, this marks the first extension of the line to cover every demand in this growing field. The three lines are: (1) Toledo—A.R.E.A. scales, engineered to the rigid specifications sponsored by the American Railway Engineers Association, forty regular styles, capacity to 70,000 lb. (2) "Truckmasters"—designed for installation where usage is less severe, 48 styles, capacities up to 65,000 lb. (3) "Truckweigh"—beam-type commercial scales, 40 styles, capacities up to 61,000 lb. Models will cover a full range of lever sizes, for platforms up to 40 x 10 ft. They will also offer a complete selection of weight-indicating methods—automatic dial, beam, type-registering beam, beam indicator, and printweight ticket-printer.

Portable Placer Machine

A NEW PORTABLE PLACER MACHINE announced by the Universal Dredge Manufacturing Company, Denver, Colo., is said to have a normal capacity from 2 to 2½ cu.yd. of bank-run material per hour. The frame is said to be of structural steel, provided with heavy gussets and is completely sectionalized to facilitate airplane or mule-back transportation. The trommel screen is designed to withstand severe abrasion and shock while operating on over-sized bank-run material. The feed hopper is constructed of steel plate and is provided with an inclosed spout which extends well into the screen. A recipro-



cating sluice is mounted on V-shaped rollers supported by angle-iron tracks which in turn are bolted to the main frame. Rubber riffles are provided and molded in one piece. The water-supply pump is coupled to the gasoline drive engine by means of a flexible coupling and is a one inch by one and a quarter inch ball-bearing pump. A water storage tank is located directly under the sluice, and is connected to the pump intake. A de-watering sand wheel can be provided and is recommended where the machine is operated some distance from water. A 1½-hp. air-cooled gasoline engine is directly coupled to the water-supply pump.

Glass Marking Inks

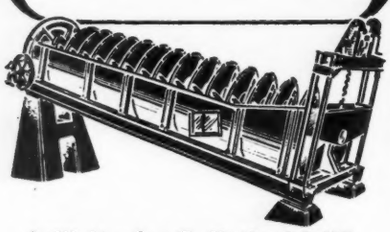
GOLD SEAL LABORATORY INKS for labeling small glass surfaces such as microscope slides and small containers are a recent offering of the Clay-Adams Company, 44 East 23d St., New York. These are ready to use with steel pen, brush, or rubber stamp, and are said to write as finely as paper inks. They are also reported to be non-acid, non-corrosive, non-inflammable, and resistant to acid, alkali, usual laboratory solvents, and high temperatures. Recommended as well for porcelain refractories and other ceramic materials. Colors, red, white, blue, and black are available.

AKINS Classifiers CUT COSTS

NO TIME WASTED
Getting Started After Shutdowns

Normal circulating sandload and normal overflow are established immediately after starting.

● It is not necessary to grind out the circuit before shut down . . . and the Classifier will always start without unloading. The AKINS will not stall on overload. Whether shutdowns are planned or forced, *these advantages result in a much higher percentage of operating time.*



★Write for Bulletin 24-HA

We also manufacture:

Lowden Dryers; Skinner Multiple Hearth Roasters; Ball, Rod and Tube Mills; Diaphragm Pumps; Smelting Equipment; Crushers and Rolls.

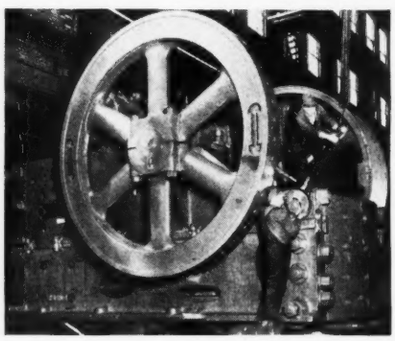
COLORADO IRON WORKS COMPANY

Main Office: **DENVER, COLO., U.S.A.**

Canadian Locomotive Co., Ltd., Kingston, Ont., Can.
Vancouver Iron Works, Ltd., Vancouver B. C., Can.
Marsman Trading Corp., Manila, P. I.
Head, Wrightson & Co. (S. Africa) Ltd., Johannesburg
Head, Wrightson & Co. Ltd., Stockton on Tees, Eng.
The Clyde Engineering Co. Ltd., Granville, N. S. W.

Coupling for Flexible Ventilation Tubing

AMERICAN Brattice Cloth Corporation, Warsaw, Ind., has devised a new coupling for use in flexible ventilation tubing said to make a substantially air-tight connection that can be readily disconnected when desired. The coupling consists of a grooved metal band, with a turned-up edge at either side, which prevents the solid ring (over which the tubing is folded) from slipping out of position. The band is split at the top to allow expansion for insertion of the rings. When closed the band forms a perfect circle, thus fitting up with the solid rings, to form an air-tight coupling. Tubing is inserted by folding back the end like a cuff and inserting the ring; then fitting it into the opened split band. The lock arm fastened brings the band together so that it fits snugly up against the tubing. The lock arm fastener on the band is said to be adjustable, to insure further freedom from air-leakage on different grades of tubing material.



One of the three large jaw crushers made by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., that will crush iron ore in the Far East. Opening measure 84x60 in. and each crusher weighs 450,000 lb. The V-belt drive has 23 grooves

New Scraper

A NEW 2-wheel hydraulic scraper built for use with tractors rated at 25 to 35 hp. is announced by Bucyrus-Erie Company, South Milwaukee, Wis. Known as the H–28, it has a struck capacity of 2½ cu.yd., but will, according to the manufacturer, heap to loads of 3 or 4 cu.yd. Since the H–28 with its tractor can be loaded on a regular truck and hauled within usual dimension and load limits, no special permit is needed to haul it over the highways. The H–28 can also be used with a rubber-tired tractor, making a complete dirt-moving and traveling layout and a high-speed all-on-rubber hook-up that will not damage hard-surfaced roads.

Temperature Control Pellets

A NEW TECHNIQUE in temperature control is announced by the Tempil Corporation, 132 West 22d St., New York, N. Y. Pellets known as Tempils are said to have a sharp and rapid melting action at the stated temperature. A 200 Tempil melts at 200 deg. F., the 300 at 300 deg. F., etc., and they are reported accurate

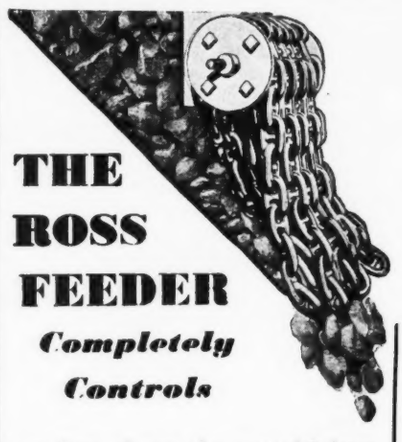
ROUGH GOING
Calls for
FLEXIBLE NAYLOR PIPE

There's *one* light-weight pipe made to order for your jobs in rough terrain—NAYLOR. Its exclusive Lockseam Spiralweld Structure makes it more flexible than any other. It's easy to handle, quickly assembled, and can be bent cold. Its greater structural strength makes it ideal for pressure service. And remember, light-weight means economy in addition to other Naylor advantages. Sizes 4" to 30" in diameter with all type fittings and connections. Complete fabrication service.

WRITE FOR CATALOG No. 37

NAYLOR PIPE COMPANY
1243 EAST NINETY-SECOND ST.
CHICAGO, ILLINOIS

NAYLOR LOCKSEAM SPIRALWELD PIPE



THE ROSS FEEDER
Completely Controls

the flow of any size material from Storage Bins, Hoppers or Open-Dump Chutes to Crushers, Conveyors, Screens, etc.

High in efficiency. Low in maintenance and power consumption.

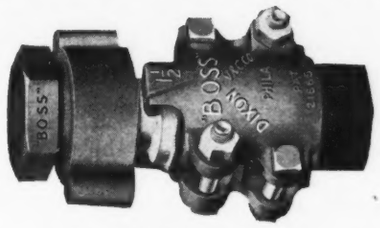
Furnished in sizes to suit your operation. Scalping unit to fit your chute if desired. Send full particulars for recommendation.

ROSS SCREEN & FEEDER CO.

19 Rector Street
New York
U.S.A.

2 Victoria Street
London, S.W.I.
England

If it's a **"BOSS"** *Connection, You Can Forget About Service Failures!*



"BOSS"

FEMALE COUPLING

WASHER TYPE, STYLE W-16

When hose lines in any type of service are connected with "BOSS" Couplings, the possibility of leaks, pressure losses and blow-offs is virtually eliminated. What's more, the life of the hose is materially increased, because "BOSS" Couplings actually protect it where it is generally first to "go"—the ends. All parts are steel or malleable iron, cadmium plated to prevent rust. Sizes 1" and larger have strong 4-bolt "BOSS" Offset Clamp. Sizes ⅞" and smaller have 2-bolt clamp.

If a washerless coupling is desired, the "GJ-BOSS" Ground Joint Female Coupling, Style x-34 should be specified.

"BOSS"

MALE COUPLING

STYLE MX-16

This is the companion coupling for the "BOSS" Female Coupling described above. It is made from the same high quality materials and incorporates the same sound principles of design. Used in place of iron pipe nipples, it is much more practical and economical, as it eliminates the need of oversize hose. Cadmium plated—rustproof. Sizes ¼" to 4", inclusive, with 4-bolt "BOSS" Offset Clamp on 1" and larger; 2-bolt clamp on ⅞" and smaller.

Specify "BOSS" Couplings on your next order, and prove them on your toughest coupling jobs. Carried in stock by leading Rubber Manufacturers and Jobbers.

DIXON

VALVE & COUPLING CO.

Main Office and Factory: Philadelphia, Pa.

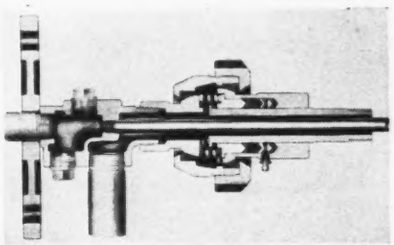
Branches:

Chicago Birmingham Los Angeles Houston

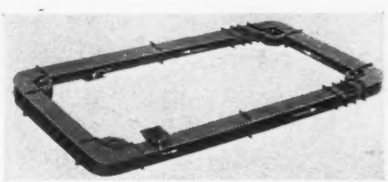
within 3 per cent of the temperature which they are intended to indicate. Each pellet is stamped with the temperature at which it melts and each range is made in a different color for simple identification. Tempils are available in ranges of 100 deg. and on request also in 50 deg. F. intervals. They are reported not corrosive to metals, and do not pit or leave objectionable stains which cannot be easily removed.

Revolving Type Flexible Ball Joints

BARCO Manufacturing Company, Chicago, Ill., announces its revolving-type flexible ball joint for use to supply steam, gas, or fluids from a fixed or



stationary supply pipe to a rotating drum or member without leakage. Herewith is shown Type 7R–8CR, with siphon adaptor 18R. The adaptor 18R is used when it is desired to feed two different fluids into the revolving drum or siphon out condensate through the same opening. These joints are said to be unique because they provide free movement in all directions when applied in accordance with instructions and lubricated.



Seeking absolute cleanliness and freedom from contamination, the Stephens-Adamson Manufacturing Company, Aurora, Ill., announces an improvement on its Redler conveyor. New construction is said to eliminate any metal to metal contact in the carrying run of the conveyor. Curved corners of 91 deg. or a combination making a 180-deg. turn are available.

New Steel Tape

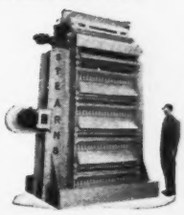
CHROME FACE is the name of the line of steel measuring tapes announced by the Lufkin Rule Company, Saginaw, Mich. They are said to be accurate steel tapes, are chrome plated, and have jet-black markings on a chrome-white surface. These tapes are said to be strong, to resist rust, and to be easy to clean. New cases and frames of improved design and appearance have been built for this new line. It is offered in two widths, ⅜ and ½ in., and in two graduations, feet, inches, and 8ths, and for engineers' use, feet, 10ths, and 100ths. These new tapes are offered also in ¾- and ½-in. widths on metal frames with plumb bobs for tank gaging.

Stearns

MAGNETIC

SEPARATORS • DRUMS • ROLLS
CLUTCHES • BRAKES • MAGNETS
WILL HELP GIVE YOU MORE PROFITABLE PRODUCTION WITH BETTER ENGINEERED MAGNETIC PRODUCTS

STEARNS Magnetic Pulleys, improved, air-cooled, powerful—for protection, purification or concentration—wide range of sizes or complete separator units. Bulletin 301.



STEARNS Type "K" High Intensity Magnetic Separators for high concentration of ores, separating highly reluctant material can be designed in multiple magnetic zones to suit type of separation and capacity. Bulletin 700.

STEARNS automatic drum-type fully enclosed magnetic separator, fast, positive protection against tramp iron in grinders, crushers and pulverizers. Bulletin 93-B.

For separating liquids or material in solution containing impurities this Stearns Type "QS" Automatic Magnetic Filter will reduce your rejects. Ceramic folder.

STEARNS Suspended magnets, circular, rectangular and other shapes and all sizes. Our Bulletin 25-B describes fully.

We will be glad to test your material, 25 to 50 lbs. prepaid, for analysis and recommendation. Avail yourself of our laboratory facilities.

STEARNS MAGNETIC MANUFACTURING CO.

624 S. 28th St., Milwaukee, Wis.

For a SAFE, PROFITABLE INVESTMENT, choose

SuperDuty
DIAGONAL-DECK
DEISTER-OVERSTROM TABLES

• Safe, sure, and profitable separation of minerals is a valuable production asset, and one you can be sure of with a Diagonal-Deck Deister-Overstrom Table installation in your mill. With inbuilt qualities of long, serviceable life, high table tonnages and all around separating efficiency, this Diagonal-Deck Table brings you added effectiveness from the day it is installed. Truly an outstanding unit both for productivity and consequent profits. Years of service only add to its value for the Diagonal-Deck Table's rugged construction means low cost maintenance. Write for details . . . No obligation.

THE DEISTER CONCENTRATOR COMPANY
THE ORIGINAL DEISTER CO.
INCOPORATED 1906
905 GLASGOW AVE · F T. WAYNE, IND.

Try THE NEW ACID-PROOF
DURAKLAD
FILTER CLOTH

A NEW FABRIC WOVEN FROM SYNTHETIC PLASTICS

Here is a new filter cloth that makes possible new efficiencies—greater economies.

The synthetic fibre from which it is woven is highly acid resistant—no fuzz or lint—require less frequent washings—highly mildew resistant —give 50% to 300% longer wear.

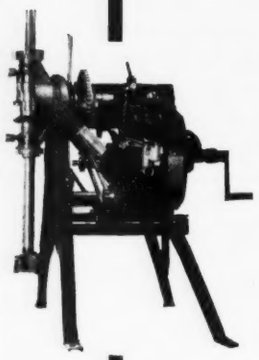
Victor Filter Fabrics are made in over 100 constructions. Widths from 18" to 120". Weights from 8 oz. to 50 oz. square yard. Include Ducks, Twills and chain cloth for metallurgical use.

Sold by the yard or cut and sewed to fit all types filters.

Large stocks carried for prompt deliveries.

Write for more information. Samples sent promptly upon request.

WM. W. STANLEY CO. INC.
401 BROADWAY
NEW YORK



INDISPENSABLE
FOR PRELIMINARY EXAMINATION
MODEL 'X-RAY' DIAMOND DRILL

Weighing only 165 lbs.—with a capacity of 150—200 ft. and extremely small power consumption. Supplied with gasoline motor. Air and electric motors available.

A complete line of Diamond Drilling equipment.

PROMPT ATTENTION TO ENQUIRIES WHETHER FOR SALES OR CONTRACT.

BOYLES BROS. DRILLING CO., LTD.
Diamond Drilling Contractors and Manufacturers
VANCOUVER, B. C.

Toronto, Ont. Kirkland Lake, Ont. Port Arthur, Ont.
Manila, P. I. Melbourne, Australia. Singapore, S.S.

INDUSTRIAL NOTES

Chain Belt Company, Milwaukee, Wis., recently announced the election of J. C. Merwin to the office of treasurer in addition to that of vice-president, which he now holds, and the appointment of L. B. McKnight as assistant to the vice-president in addition to sales manager of the company's conveyor division.

Western Precipitation Corporation, Los Angeles, announces the opening of a sales and engineering office in room 1137, Marquette Building, Chicago. A. W. Robinson, who has been associated with the corporation for many years, is in charge of operations in the central states.

Marmon-Herrington All-Wheel-Drive Pictorial News, describing and illustrating the industrial use of all-wheel-drive trucks, will be mailed on request to Marmon-Herrington Company, Indianapolis, Ind.

Mailing List of British Columbia Mines. The Chamber of Mines, 402 Pender St. West, Vancouver, B. C., has published a mailing list of provincial mines for business and supply houses, dated April 1, 1940. The list gives name of company, executive office and mine addresses, type of power, capacity of mills, and name of mine manager. The list is free of charge only to members of the Chamber of Mines.

BULLETINS

Aridifier. Logan Engineering Co., Chicago, Ill. Bulletin 340 describes and illustrates the manufacturers unit for removing moisture, oil, and dirt from compressed air and gas. Pp. 4.

Mine Lamp. Koehler Mfg. Co., Marlboro, Mass. Folder describes and illustrates the manufacturer's new mine lamp offering beam flexibility. Pp. 4.

Cable Compound. General Cable Corp., 420 Lexington Ave., New York, N. Y. Leaflet describes Insolozite, a plastic filling for electric cable use. **Terminals.** Folder describes the manufacturer's Type SS improved type of soldered porcelain terminals. Pp. 4.

Welders' Ear Protectors. Mine Safety Appliances Co., Pittsburgh, Pa. Bulletin CF-4 describes the manufacturer's ear protectors for welders. Pp. 1.

Rod Deck Screen. Nordberg Mfg. Co., Milwaukee, Wis. Bulletin 94 describes and illustrates the features of the manufacturer's new Symons rod deck screen. Pp. 4.

Foot Protection. Mine Safety Appliance Co., Pittsburgh, Pa. Bulletin CK-1 describes and illustrates the company's new flexible steel safety insoles for working shoes. Pp. 1.

Pipe Tools. Beaver Pipe Tools, Inc., Warren, Ohio. Catalog 40 describes and illustrates the manufacturer's new small threader for pipes from ⅛ to ¾-in. diameter, together with other models of pipe tools. Pp. 24.

Explosives. Atlas Powder Co., Wilmington, Del. Catalog No. 9 describes the company's entire line of explosives and blasting accessories. Pp. 43.

Lubrication. The Farvol Corporation, 3249 East 80th St., Cleveland, Ohio. Bulletin 20A describes features of the manufacturer's units for a centralized system of lubrication. Pp. 7.

Portable Core Drill. Acker Drill Co., 725 W. Lackawanna Ave., Scranton, Pa. Bulletin 21 describes and illustrates lightweight portable core drills for surface and underground exploration. Pp. 8.

V-Belt Drives. The B. F. Goodrich Co., Akron, Ohio. Catalog Section 2180 describes fractional-horsepower V-belt design, and its selection for industrial use. Conversion of belt number and fractional horsepower V-belt pulley groove top widths are also given. Pp. 24.

Ventilation Tubing. Hersey & Co., Inc., 2021 Munor North, Seattle, Wash. Bulletin 26 describes the company's "Ruburtite" ventilation tube for mine use. Pp. 2. **Oiler.** Bulletin 21 describes features of its one-half pint size oiler for rock drills. Pp. 1.

Flotation Reagents. American Cyanamid Co., 30 Rockefeller Plaza, New York, N. Y. This is the second edition of the company's Ore Dressing Notes No. 7 that includes data concerning the properties and uses of the newer flotation reagents and of improved reagents and describes the newer fields in which flotation has been adopted, principally the applications in the field of non-metallic minerals. Pp. 29.

Welding Guide. Linde Air Products Co., 30 E. 42d St., New York, N. Y., offers a guide in the form of a printed 15x12-in. chart for welding 30 different metals and alloys.

Induction Motors. Reliance Electric & Engineering Co., Ivanhoe Rd., Cleveland, Ohio. Bulletin 118 describes and illustrates the company's Type AA induction motor. Bulletin 502 describes its motor-generator sets. Pp. 4.

Leather Packings. Chicago Belting Co., 113-125 No. Green St., Chicago, Ill. The company offers a "Handbook on Hydraulic and Pneumatic Leather Packings," which contains comments on the design and application of replacement packings. Pp. 50.

Leather Belting. Chicago Belting Co., 113-125 No. Green St., Chicago, Ill. The manufacturer's condensed catalog describes and illustrates features of modern leather belting for many industrial uses. Pp. 24.

Crushers. Straub Mfg. Co., 501 Chestnut St., Oakland, Calif. Bulletin 38 describes the company's line of crushers and grinding units. Pp. 4.

Welding Equipment. Victor Equipment Co., 844-50 Folsom St., San Francisco, Calif. Catalog for 1940 attractively illustrates and describes the company's complete line of welding and cutting equipment, regulators, gages, adaptors, and connections. Pp. 30.